THE
ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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READY!

THE UNIVERSAL ELECTRICAL DIRECTORY
(J. A. BERLY'S).

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RAIL CORRUGATIONS.

THE papers on this subject which have recently been read, by Mr. Arnall before the Civils (Students), and by Mr. Panton before the Electricals, will have the effect of reviving interest in it, but neither can be said to add much to enlighten us on this difficult and obscure matter. Both, in fact, do little more than repeat what we have heard already from the same men, and in Mr. Panton's case the paper is very nearly a reproduction of an article which he wrote for the *Light Railway and Tramway Journal* last May. His theory was outlined in our issue of August 3rd, 1906, and reference to the abstract of his paper printed elsewhere in this issue does not bring any new facts to light. The omission of any remark about a double-ended drive might be interpreted to signify that Mr. Panton's experiments have not yet been successful. If such a drive can be devised to work inexpensively and without noise, advantages will be obtained even though corrugation may not be cured. Mr. Panton finds practical grounds for believing that better built trucks, which will not twist easily, are likely to reduce the extent of corrugation, although he treats the one-sided drive round a checked curve as productive of the greatest mischief.

Mr. A. T. Arnall, in a paper read before the students of the Institution of Civil Engineers on the 8th inst., deals with his theory of the formation of corrugations in mathematical form. His deductions and conclusions are of great interest and value, although they were confined in the paper to the production of the phenomenon at curves. There is a pretty general agreement that the outer rail on slow curves suffers first, and straight track afterwards.

No tramway official is complete without a theory of the cause of corrugations, and a great deal of nonsense has been talked and written in consequence, with the result that the subject, from being cloudy, is becoming opaque to those who are not gifted with a special sense of discrimination. The *Tramway and Railway World* follows another contemporary by printing opinions obtained from over 50 managers, and the only noticeable and refreshing thing about the five pages of close type is that 16 managers have formed no definite opinions, or nothing but negative opinions. At one time we began to classify the different theories, but we gave it up long ago as waste of time.

It stands to reason, of course, that the overhauling and strengthening of existing trucks, and the adoption of a more stringent specification for the construction of new ones, cannot fail to be of very great benefit to the rolling-stock and track, whether they prevent corrugation or not. It has long been common knowledge that the average foreign-made four-wheel truck, together with the cheap British imitation which was put on the market in the early days, was of indifferent design and worse construction, and we fear that

the majority of British cars to this day are equipped with this class of truck, put in with a mistaken idea of cheapness. As regards the rails, the statements put forward in the discussion on Mr. Panton's paper, to the effect that hard rails did not appear to be liable to corrugation, deserve serious attention. The specification issued by the Engineering Standards Committee was subjected to criticism on the ground that the composition of the rail as there defined led to a deficiency in hardness; and, in view of the weighty experience and authority at the back of this allegation, it would seem at least desirable that the Committee—which fortunately is of a permanent constitution—should take the matter into consideration at an early date, with a view to the possible amendment of the specification after due inquiry.

Since we printed a review of the whole question, little really new material has come to hand, and we do not feel that much more can be said until the Joint Committee, which is preparing a report, has published the results of its labours.

Fire follows Folly.

On another page something is said about the fire risk of an electrical installation being almost non-existent when the work is done decently and looked after with some share of attention.

It is a trite remark that the jerry wirer and the fool, if left to themselves, would soon bring electricity into grave disrepute, and they are always doing their best to accomplish this, as can be seen now and then when insurance companies go into details. There are some charming examples in the last quarterly report of the (American) National Board of Fire Underwriters; for instance, a building was wired for 16-c.p. lamps, but it was thought that 140-c.p. lamps would give more light. They did.

An attendant bestowed great care and a lot of naphtha on the cleaning of a lift motor. No one wanted the lift for quite a time.

Arc lamps were hung temporarily in a room, and fed through cotton-covered wire hitched over the picture moulding. Then a man came along with tacks and bunting, and last of all they switched on current. And so on.

Then there is Mr. Arthur B. Weekes's little tale in the *Engineers' Review* (U.S.A.).

After all it does not cut any material ice on a gas system if you don't put fuses or circuit-breakers here and there, although an occasional valve is useful, but there has been a time in Mr. Weekes's experience when someone regretted that there was nothing but an open knife-blade switch to break a high-tension circuit between generator and transformer. It is unwise also to practise tying up high-tension circuit-breakers too often; and in England the death of fitters, while working on switches charged with between 2,000 and 11,000 volts, might be productive of criticism.

This note may well be ended with a *verbatim* quotation from the fitting finish of Mr. Weekes's article:—

"Sometimes it is necessary to place thermometers on the cables, readings being taken during the excess load. There is always a liability to fire. The writer has seen cables so hot that the solder in switch terminals has melted out."

Oh, *what* a happy land is England!—thanks to the B. of T. and the Home Office.

Facilities v. Red Tape.

In view of the severe competition between electricity and gas for lighting and heating, and the admitted fact that electric heating can hope to oust gas heating only by virtue of its greater convenience and hygienic superiority, it is obvious that electricity supply undertakers cannot afford to tie their hands with red tape, or to hedge themselves about with harassing rules and regulations. As a rule, we believe, municipal authorities are supposed to be less conciliatory and more haughty than companies in their dealings with consumers and contractors, and, therefore, it was with surprise that we recently heard of a West-end company which refuses to supply electricity for heating at the low rates, unless all the heating circuits are run in steel tubing—and insists on this being done, even when wood casing has already been fitted up.

There are about 30 different authorities engaged in the supply of electricity in the metropolis, and each of these, in addition to its own voltage, its own frequency, its own system of supply, and other idiosyncrasies, possesses its very own code of rules and regulations, which are, of course, better and wiser than all or any other rules in existence. Uniformity is, apparently, the bugbear of English electrical engineers, and even the Standards Committee can only point the right road, without being able to enforce its decisions. In the case in question, the company chooses to insist upon what seems to be only a fad, to its own detriment. The idea appears to be that the consumer will find it more difficult to tap the heating circuits for lighting purposes if they are enclosed in steel tubing—even of the close-joint type—than if wood casing is used. We need not dwell on the absurdity of this idea. We can only say that obstruction of this kind will never, never, promote business—to do which is far more important than to put obstacles in the way of wrong-doers—and that it brings its own punishment in the shape of petty annoyance and disgust. What is wanted in these matters is a judicious blend of common-sense with "give-and-take" and a large proportion of the "desire-to-please."

The Use of Peat for Power Production.

The numerous experiments on the concentration of peat for fuel purposes have not hitherto proved commercially successful, chiefly because of the great ratio of the volume of this fuel to its heating value, and the impossibility of making use of some of its components, such as the large percentage of nitrogenous matter, for heating purposes. On this account the peat industry has fallen off rather than increased during the past ten years, in spite of the widespread increase in the coal industry. Of the various peat concentration processes, Ziegler's has perhaps proved most economical. This process, besides producing a homogeneous and pure coke, enables part of the nitrogen to be recovered in the form of ammonia, and also gives other useful by-products. Even this process, however, which has proved a technical and financial success in Upper Bavaria, is not suitable for use on a large scale, and the *Elektrotechnische Zeitschrift*, in a recent review of the subject, considers that real success will only be attained when the peat is vaporised and employed for driving large modern gas engines generating electric power. Such engines are already largely employed with blast-furnace gases in units up to 5,000 h.p.—the number of such large gas-engine installations in use in Germany, for instance, in April, 1906, was 391, with a total power of 416,000 h.p. A process based on this principle for the use of fuel stuffs unsuitable for coke formation or for blast-furnace work is due to Mond, and this has been recently improved in combination with Dr. N. Caro, of Charlottenburg. In this case the low grade fuel is vaporised in a mixture of air and high temperature steam, and experiments carried out at the Mond works, at Stockton, have shown that not only finely divided coal residue, but also wet peat containing 50 per cent. to 55 per cent. of water, can be successfully dealt with, whilst the output of ammonia is considerably

increased. This experiment is to be continued in Germany with the support of a number of manufacturers, and with a capital outlay of £37,000 a large installation is to commence operation near Herne this spring. The chief improvement in the new method is that the direct use of the wet peat avoids the heavy cost of the preliminary drying process, and at the same time an increased quantity of valuable manuring material results as a by-product. Should the experiment prove successful, it may lead to the rapid industrial development of the hitherto neglected peat moors, not only in Germany, but in the United Kingdom.

Submarine Cables.

It is not often that questions relating to submarine cables are discussed in the Courts. As a general rule, they either lie so deep or their situation is so well known by mariners that fouling by anchors seldom takes place. What the rights of the owners of the cable and the owners of the anchor would be in an ordinary case we should not like to say; but, from a recent case in the King's Bench, it seems that such rights are sometimes adjusted by agreement.

In the case in question the defendants, who were two submarine telegraph companies having cables laid across the bed of the Yang-tsze Kiang River, with a view to the preservation of the cables from injury, issued a notice in which they stated that cables, when caught by ships' anchors, chains, &c., were usually damaged or broken in the endeavour to free the gear, the latter at the same time being often lost or destroyed, and that they had therefore decided to compensate owners of vessels for loss of material from the above causes by adhering to the Submarine Telegraph Act, 1885, Schedule, Art. VII, according to which owners of vessels who could prove that they had sacrificed an anchor, &c., in order to avoid injuring a submarine cable, should receive compensation from the owner of the cable. The plaintiffs' vessel anchored in the river, and both her anchors fouled the defendants' cables, and the captain, in order to avoid injuring the cables, slipped the anchors and cables. In consequence of the loss of the anchors the vessel was detained for eight days at Shanghai, and damages were claimed in respect of this. It appeared that the cable which was fouled by one of the anchors was an abandoned cable. It was held that the plaintiffs were entitled to recover the damage which naturally flowed from the loss of the anchors, and not merely the value of the anchors and chains, and that the fact that the cable was an abandoned cable made no difference. It will be seen that the claim in this case was based upon a special contract. Had there been no contract, there would probably have been no liability at all on the part of the cable company.

A New Form of Overhead Conductor.

In the very dawn of electric street traction a rigid tube was suspended over the track; now an American suggests that a heavy steel rod is going to be better than the usual copper wire—or rod, as it has become under the conditions of catenary suspension. He proposes for a speed of 80 M.P.H., a rod having a diameter of 1¼ in. suspended every 12 ft. in a span of 300 ft. by light tension rods or wires without springs.

These rods will never be in compression. The sag at the centre of each 12 ft. span is said to be one-ninth of an inch, and even this small amount will produce oscillations in the collecting roller which will vary the upward pressure from 42 lb. *maximum* to 9 lb. *minimum*, when the pressure with the collector at rest is 20 lb.

Mr. Mayer, who originated this proposition in a paper read before the American Society of Civil Engineers, assumes that the sag will be no more than ⅛ in. under all variations of temperature, even to the 140° F. which he quotes as the experience in the Northern States, and that is to be secured by the use of expansion joints at suitable intervals. Probably the great weight of the construction, and the variation in length due to temperature, will be the greatest difficulties in the way of anyone who uses this principle; although, with regard to the weight, Mr. Mayer points out that the heavy steel rod requires but one catenary rope and single suspenders, while the copper wire conductor for similar service must have two suspension wire ropes, and stiff triangular suspenders, in order to minimise lateral motion due to wind.

Certainly the more general introduction of speeds exceeding 70 M.P.H. must be preceded by some modification of the present styles of construction, but there is no more reason to expect radical and sudden alterations in the overhead equipment than has been seen in the infrastructure, which has passed through a continuous succession of slight modifications spread over a long period of years, following the curve of gradually increasing speeds and rolling loads.

Nothing but an aerial system of some kind seems likely to find general acceptance either for tramway or railway work, especially as we approach the high-tension period. Conduit and surface contact may be repeated under special circumstances; the third rail has a sphere of usefulness which is getting towards definition, and is not doomed to vanish into the limbo of obsolescence, but the overhead conductor will remain for long the more usual.

Mr. F. J. Sprague is amongst the foremost champions of the third rail against all comers, but the abstract of his arguments for and against, as reported by the *Street Railway Journal*, reads like an admission that the wire is better than the rail. The fact is, of course, that there is no utter best; both will play their parts, and sometimes, owing to the fallible personal element, they will be made to exchange *rôles*, and the results will be conspicuous.

Trailers.

The B. of T. seems to be relaxing its objection to the use of trailer cars, although there is some reason to think that a good number of tramways of comparatively early date have had the power to use them if they wished to do so.

Upon the Continent, and to some extent in the U.S.A., the use of coupled cars, only one of which is equipped with motors, has met with considerable favour; and, judging from the length of their service, it is natural to suppose that the system is satisfactory from the points of view of the owners, the public, and of the governments concerned.

If there were any great general desire or any real need for trailers in this country, we cannot help thinking that the pressure of public opinion on the B. of T. would have produced the increased licence before now; and the fact that even at this date each application for permission to use trailers is considered with reference to the special circumstances of the case (*vide* Sir H. Jekyll's letter to the Editor of the *Light Railway and Tramway Journal*), taken together with the information that permission has been given in seven cases only during the last seven or eight years, makes us feel that trailers are not popular, quite apart from any official wet blanket.

Why this is so we do not profess to understand at present; there must be lines, especially such as are of a rural nature, upon which trailers would be of great assistance in times of stress; and many a town tramway which keeps 20 per cent. or 30 per cent. of its rolling stock locked up for 360 days out of the 365, *might* have done better to keep less capital lying idle by purchasing light trailer cars as part of the holiday reserve.

The *might* above may be far from right, and one weighty argument against the use of trailers for holiday traffic is that the speed of the journey is reduced just when it ought to be kept up, in order to lessen the number of motor cars required for a given service. Moreover, it is demonstrable that a motored car costing £800 will pay for itself, and that handsomely, if used on holidays and other special occasions aggregating less than a fortnight per annum.

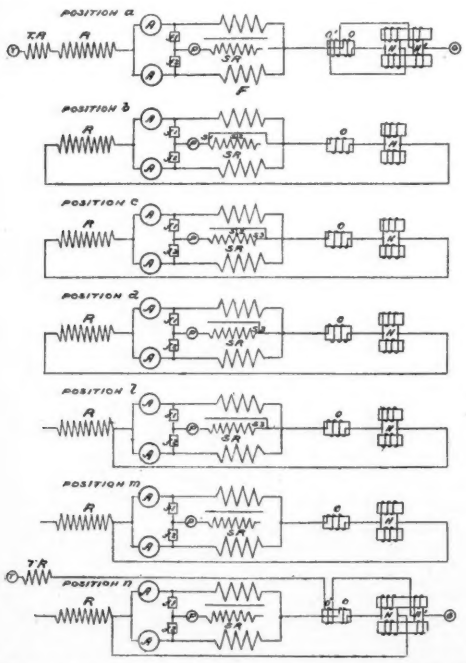
IMPROVEMENTS IN THE MAGNETIC TRACK-BRAKE.

Recent correspondence in these columns has shown that the magnetic brake, which depends entirely upon the motors for its excitation, is regarded in some quarters with a degree of suspicion or anxiety. Possibly this feeling attaches chiefly to that form of brake which produces part of its effect by direct action on the wheel-rims through the ordinary brake-shoes, for the idea that the Highgate and other accidents were caused by this brake locking the wheels, and so preventing its own effective operation, is hard to drive out of some minds. We need not say that it is an erroneous idea and a mischievous one. The hand-worked wheel-brake is the real danger, and much will be gained when it is discarded entirely.

Some of our correspondents advocated the use of line current for the service application of the magnetic brake, falling back on the motors in case the prime supply should be cut off. Something of the sort would make this brake even more reliable than it is now, but we prefer the arrangement devised and patented by Mr. Newell (*vide Western Electrician*, February 9th), which seems to offer the same safeguards, but with economy.

Mr. Newell uses two controllers, one containing the standard power and reversing connections and the other the brake connections, both being interdependent.

The chief object of the invention is to control the brake magnets by means of a variable shunt across the generator (motor) fields which is brought into operation by an automatic voltage regulator; and another highly important object is the provision of connections whereby the line current may be utilised either for "priming" the fields of the generators, preparatory to closing the brake circuit, or for energising the brake magnets directly, so that a car may be held at a stand on a grade.



T, Trolley; T R, Supplemental resistance; A, Armatures; f_1, f_2, Fuse-blocks; Shunt switch closed by voltage regulator; S R, Shunt resistance, variable by hand; F, Motor fields; o, o^1, Blow-out magnet; H, H^1, Brake magnets; G, Earth.

Circuits corresponding with various Positions of Braking Controller.

This novel arrangement and combination of circuits removes the two objections to the magnetic track brake which have been raised whenever it has been under discussion. The first of these is that the time lag of the brake, after the controller handle has been moved, is appreciable if the motor magnets have not been excited either in braking or running just previously; and the second is that some auxiliary brake must be used to bring the car to a dead stop and to hold it so on a hill.

The "voltage regulator" consists of a simple form of switch operated by a solenoid in the main brake circuit, and it brings the shunt across the fields into circuit on the notch of the controller next to that on which the line "priming" current has been used. By reference to position *b* on the figure, it will be observed that the whole of the series-braking rheostat is in circuit, and that the fields are weakened by a shunt of large capacity, so that the first application of the brakes is tempered. Gradually the shunt is weakened and the fields strengthened, and afterwards the strongest effects are produced by cutting out the series resistance. The regulator is designed to insure the building-up of the fields to give sufficient current for braking at all speeds, and does not close the shunt until the fields have begun to control the brake magnets, this being made more certain by means of the line current on the first notch.

These improvements ought to go a long way towards convincing even the Mozleys of this world that the magnetic brake is vastly more convenient than the laboursome and slow mechanical slipper brake, and we feel that the day is at hand when the car will be lightened and the maintenance charges reduced, by the absence of the levers, floating beams, equalising rods, and the whole paraphernalia peculiar to the hand-power wheel and track brakes.

The time must come, and may come soon, when tramcars will be controlled as surely, and with as little manual exertion, as the electric trains in our tubes, although probably not by the same medium.

THE COMPARATIVE FIRE-RISK OF ELECTRICITY AND GAS.

Record is being made continually in our columns of the more serious fires, explosions, and asphyxiations, which are caused by gas in Great Britain; and of so commonplace a nature is the news that it seldom finds more than small type in a brief note.

Electrical mishaps of the same nature—barring poisoning and suffocation, in which gas has a corner—are of more direct interest to our readers and are given greater prominence. Far from seeking foolishly to cover them up, we follow them through to the end of the inquiry or inquest, or law-suit, and seek to produce the moral effect of a horrible example. If this had to be done frequently, we should despair of compassing any good, but the very rareness of serious accidents, and especially of accidents affecting property, makes each lecture salutary, and points to the comparative safety of electricity for lighting and power.

Gas has made for itself an immense field, and holds it well. Electricity, used by the unit where a decade since it was used by the twentieth part, has not checked, and will not check, the prosperity of the gas industry. The two can expand side by side; not without gradual alterations of spheres of influence and the breaking-down of certain boundaries, which at one time may have looked like other delimitations, well set up and enduring; nevertheless, they can flourish together, and may do so one day amicably without backbiting and recriminations, mutual now. Meanwhile, the champions of electricity are bound for their honour and the sake of their lady-love to take up the gage hurled by their opponents, protesting on occasion that they are but scurvily treated, and not after the fashion which knights use.

It comes about, therefore, that we, against all inclination, find it necessary to rebut, not once, but many times, the charge that electricity remains a demon untamed in the hands of our brethren, and in fair play press home the invariable victory by carrying an edged *tu quoque* into the enemy's camp. With what pleasure, then, do we read in a recent issue of the *Journal of Electricity, Power and Gas*, U.S.A. (observe the adversaries already hand in glove) that electricity has not played a very saturnine part in the fire statistics of Germany. From 1899 to 1904 fires caused, or said by the insurance companies to have been caused by electric failures, amounted to 204, 226, 265, 238, 248 and 278. The tendency has been towards increase, but on how minute a scale relatively to the vast advances in the supply

of electricity! again, 36 German public insurance associations published the following statistics :—

	1897.	1898.	1899.	1900.	1901.
Total number of fires ...	16,950	17,133	18,947	18,316	19,941
Whereof caused by—					
Children and matches ...	967	1,012	1,128	1,080	959
Petroleum explosions ...	367	362	414	354	415
Gas explosions	67	68	65	57	87
Electricity	22	25	51	42	73

and in Berlin in the year 1904-5 there were 12,788 fires, of which 30 were due to gas, and 25 to electricity.

When it is noted that the most trivial outbreak is included with great blazes in the figures above, the extraordinarily safe nature of the two favourite modern illuminants is still more apparent. Truly the result leaves us astounded, but the evidence seems unimpeachable.

To be quite fair to gas, it ought to be remembered that the points of application probably were much more numerous than those of electricity, so that a direct comparison of the safety of the two systems cannot be drawn from the table.

As we write comes in further material, very germane, under the covers of that lively advertisement "Installation News." There, in just indignation at an anti-electric speech by Herr Schaefer, a member of the Berlin District Gas Association, is a counterblast to the German's statistics, which is gathered from the Annual Reports of the Liverpool Salvage Corps. It is more than probable that these figures are of a pattern with the rest of England, and they are sufficiently interesting to reproduce here :—

1894	599 fires	30 gas	1 electric
1895	676 „	35 „	none „
1896	700 „	47 „	„ „
1897	729 „	50 „	1 „
1898	861 „	76 „	4 „
1899	905 „	50 „	6 „
1900	789 „	66 „	8 „
1901	862 „	62 „	6 „
1902	931 „	55 „	17 „
1903	864 „	64 „	14 „
1904	908 „	71 „	12 „
1905	887 „	60 „	15 „

We recognise, not for the first time, that comparative statements of this high-class description do not show up gas as a fearful instrument of destruction, and, candidly, we are glad of it. All that the electrical interests require is fair play and fair figures, and all they maintain is that electricity when properly installed and treated with as much respect as a system of gas pipes, is as unlikely to start a fire as an equally well installed gas service, and less likely to maintain one when started, while it is entirely free from the risks of explosion and poisoning.

We should like to be, in fact, pro-electricity rather than anti-gas; but under existing conditions of irritation it is pardonable, perhaps, even if it is not strictly ethical, occasionally to retaliate in a somewhat similar manner.

COMMERCIAL DEVELOPMENT OF ELECTRICITY SUPPLY.

By R. BORLASE MATTHEWS, Wh. Ex., A.M.I.C.E.

(*Concluded from page* 380.)

At a recent meeting of the Students' Section of the Institution of Electrical Engineers, Mr. W. Bernard Thompson presented a very interesting paper on this subject, which is rightly receiving so much attention at the present time. The paper was of all the more value, since it dealt with the practical experience of one who has been connected with companies that are making definite efforts to secure new business along modern lines.

In referring to the fact that the average supply authority is not doing anywhere near the business it should, it was pointed out that one very important factor that militated against the increase of business was the ignorance of the general public as to the modern means of adapting electricity to every-day use. This factor must be fully realised by the supply authority if it decides to embark on a scheme of commercial development.

The majority of supply undertakings were designed primarily for lighting, regardless of the fact that in time a demand might arise for a cheap and reliable supply for other purposes, with the result that such undertakings are saddled with plant and distribution systems quite unsuited to the demands of to-day.

In the attempt to make these stations financially successful, a cheap supply is sometimes given for use during the day at prices which carry no administration or capital charges. This still keeps the lighting consumer as the mainstay of a large number of undertakings, whereas the addition of a day load should be a means of reducing the cost of lighting to the general public. Fortunately, the majority of undertakings have plant which is small compared to the area supplied, so there will be a better chance for them to remodel and extend it to meet these demands successfully.

Diversity Factor.—The great diversity of the demands made by the various consumers on the central station supply enables a far better load factor to be obtained there than would be the case with the plant of any individual consumer, this alone going a long way towards making it cheaper for a manufacturer to take a supply from a public service rather than to generate it himself.

The following table given by Mr. Thompson shows the consumptions of different classes of consumers. The averages in the last two columns are taken from a large number of returns for each class of consumer :—

Class of consumer.	Total H.P. installed.	Number of motors.	Units per H.P. per year.	Average per H.P. per year.	Consumers' per cent. load factor.
Printers ...	4	2	450	700	8
	1	1	968		
	25	1	690		
	10	1	652		
	3	1	1,200		
Clothworkers ...	6	2	666	903	10·25
	5	2	820		
	2	1	900		
	8	1	1,225		
Platers, polishers ...	12	1	986	1,140	13
	7	1	811		
	5	2	1,428		
	5	1	1,348		
Wood-workers	4	1	760	452	5
	22·5	3	449		
	23	4	304		
	27	4	295		
Engineers' shops	15	1	595	500	5·75
	15	4	253		
	17·5	4	508		
	10	1	646		
Barber	2	1	105	300	3·25
Butcher	2	1	100		
Baker	6	1	222		
Chaffcutter ...	3	1	120		
Organ-blower ...	9	1	336		
Boot repairing ...	1	1	526		
Box-making ...	5	1	773		
Book-binding ...	28	4	832		

This table is of special interest, as it gives in a form that is not usually available the actual load factors of several different classes of consumers—data which are of great value to central station managers and canvassers when dealing with prospective consumers. The load factor is taken to be the ratio of the units consumed to the units that would have been used if the motors had been run at full load for a period of one year without stopping. The average consumers' load factor will then be the ratio of the total units consumed per year by all the consumers to the total kilowatts connected multiplied by the number of the hours in the year (viz., 8,760). It is, of course, well known that the station load factor in every case exceeds this to a greater or less degree, due to the fact that the maximum demand on the station never coincides with the kilowatts connected. This is a very important point in the supply of electricity, for it is only on account of the diversity factor that it is possible to have apparatus of greater kilowatt capacity connected to the mains, than the kilowatt capacity of the station. This diversity factor may be taken to represent the ratio of the kilowatts connected to the maximum demand in kilowatts at the station. The station load factor will

then be the average consumers' load factor multiplied by the diversity factor.

Rates.—The action of some of the municipal authorities in deciding to adopt a maximum power rate of one penny per unit was criticised as being commercially unsound; apparently this rate was arrived at without duly considering the earning qualities of each class of demand, and comparison with the cost of the competing gas supply required to attain the same ends. It was suggested that the system adopted by some of the supply authorities, of charging a fixed flat rate for power, subject to a varying discount according to the consumption per kilowatt demanded per year (which is really load factor) was a fair way of charging, and might with advantage be more widely employed for all classes of demands. The adjustment of tariffs on this principle, it was put forward, would help to attract every class of consumer according to its revenue-earning capacity to the station, and if the initial rate is based on the time of demand, it will protect the undertaking against risk of loss.

Canvassing and Advertising.—The author of the paper referred to the fact that systematic advertising (including a monthly magazine) made all the difference in the returns obtained from personal canvassing. His ideas as to the qualifications of canvassers were as follows :—"They should, of course, possess all the qualifications which go to make a successful seller of any commodity, such as affability and the habit of adapting themselves to circumstances. Industry and perseverance are also essential, but should be tempered with a knowledge of where the latter ceases to be a virtue and becomes a nuisance."

In considering the details that a canvasser should be acquainted with concerning the applications of motors, Mr. Thompson pointed out that a fly-wheel would often be of great advantage in improving the load factor of a motor. In residence lighting, ceiling lights should be employed in preference to electroliers, as in this way the nearest approach to reflected light, which was the ideal means of illumination, was obtained. Sign and shop-window lighting was mentioned as a practically undeveloped field that should produce good returns.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

New Ear for Trolley Lines.

Messrs. S. Dixon & Son, Ltd., Leeds, have just placed on the market an entirely new mechanical ear for use in suspending the trolley wire of overhead electric tramway systems. The design is novel and ingenious, and it is claimed that it will fulfil exactly the requirements of all tramway engineers. The metal of which the clamps are made is specially hard rolled, and has a breaking strain of over 29 tons per sq. in., as against ordinary cast gun-metal ears made from the best Admiralty mixture, the breaking strain of which is 19 tons per sq. in., this being a desirable feature when considering the extreme importance of securely holding up the trolley wire. Light weight combined with great strength is what is required, and it has long been aimed at by engineers. Another important feature of this ear is the combination and interchangeability; every part being made to standard gauge, each part can be renewed separately at any time, thus obviating the necessity of scrapping the whole of the ear as is done at present. Other claims set up for it are the ease and simplicity of fixing, and the neat and effective way in which a straight line ear can be made into an anchor or a feeder ear. The ears are made in five distinct types, viz.:—Clip type for grooved wire; clip type for round wire; sweated type for round wire; clip type for fig. 8 wire; clip type for bow trolley wire; the extra attachments are for anchor and feeder ears. Messrs. Dixon are also the patentees and makers of an automatic splicing ear, which can also be supplied in the form of an emergency splicing sleeve. The arrangement is such that when the broken ends of trolley wire are inserted in the ends of the sleeve and pushed home, the wire is automatically gripped by steel cone grippers, and held in position. Repairs can be instantly executed with this ear. Every emergency wagon should have two or more in its equipment. They are claimed to be very neat and quick in their application.

"Danger" Indicator.

We have received from Mr. H. J. Gridley, of Hampton Wick, particulars of an indicator designed for working with a single connection on any alternating-current circuit of 1,000 volts and upwards, and without any earth wire. The fixing lug of the instrument (fig. 1) makes the necessary connection to the bus-bar or other conductor, of which it is required to indicate the live or dead condition. The deflector which swings in front of the window in the ebonite cover of the instrument being suspended on a tight wire fixed top and bottom, no delicate levelling or adjusting of the indicator is necessary, and this arrangement also makes the instrument capable of withstanding rough treatment and vibration. Damping of the deflector in places of excessive vibration is also allowed for.

The deflector is twisted against the torsion of its suspending wire by the combined repulsion and attraction of specially-shaped conductors, so that the danger signal rests in front of the window when indicating, and is withdrawn to one side of the window when free.

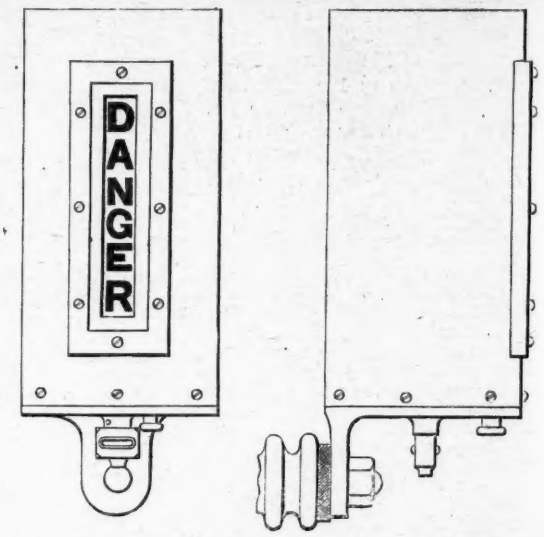


Fig. 1.—Front and Side Elevations of "Danger" Indicator.

If by any mischance the suspending wire of the deflector were to break, warning would be given of this by the danger signal falling down across the window, thus obviously showing that the indicator was out of order, and no reliance was to be placed on it. Cheapness, as well as simplicity of construction, has been aimed at in the design of the indicator, so that it may be used in considerable numbers without great expense.

A low voltage and hand detector is also being brought out, for a similar purpose.

Coin-Counting Machine.

We recently inspected a machine which will count and wrap coin with perfect accuracy, and as rapidly as five or six expert cashiers; it is being introduced by the British Coin Handling Machine Co., Ltd., 6 & 7, King William Street, E.C. The machine, which is shown in the accompanying fig. 2, was arranged to count shillings

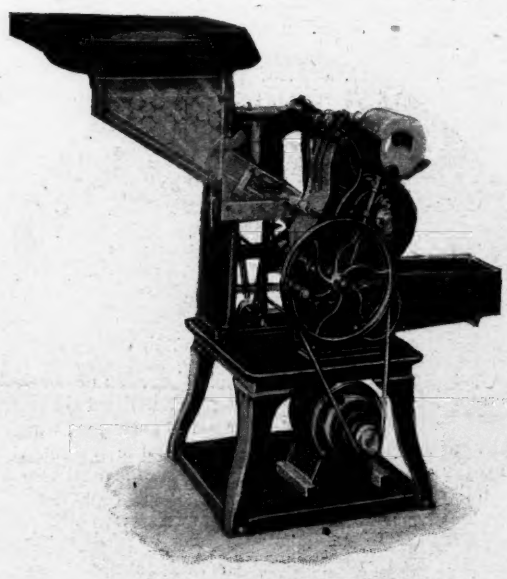


Fig. 2.—Electrically-driven Coin-counting Machine.

and wrap them up in *rouleaux* of 40. The coins are fed into the machine through a chute, and assembled into line at the end of the chute. Each coin as it passes into line is automatically counted, and the number of coins in line is shown on a dial. As

the last of forty coins falls into position, the roll of coins is gripped automatically, carried under a roll of strong paper and wound securely, each end of the roll being simultaneously beaded (fig. 3). It is then dropped into a receptacle, labelled with the denomination and amount, and if desired, the title and address of the bank or firm as the case may be—all at the rate of from 400 to 500 coins per minute. The complete rolls of money with their neatly beaded ends look like cartridges, and are so securely wrapped that it is impossible to extract a single coin without destroying the whole roll.

The machine is actuated by a small electric motor of $\frac{1}{6}$ H.P.

In view of the millions of pennies alone which are continually

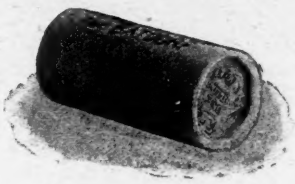


FIG. 3.—COMPLETE MACHINE-MADE ROLL OF MONEY.

passing through the hands of concerns using automatic penny-in-the-slot machines, to say nothing of the receipts of tramway, 'bus, and tube systems, which largely consist of copper, there ought to be a large field for this ingenious machine.

We were also much interested in a wages-paying machine, which looked like a cross between a cash register and a type-writer; this machine, on the pressure of a single key, delivers instantly any sum from 1d. to 10s., in silver and bronze coin, and by pressing another key any sum in gold from 10s. to £2 is also delivered; the latter key is worked by the left hand, and the former (together with a bar for halfpence) by the right, so that a single operation produces the exact sum required. The great economy of time effected by the use of this machine when paying large numbers of men is obvious. The only apparent drawback to it is the necessity of first paying the machine.

New Moving-Coil Instruments.

We have received particulars of a wholly new series of measuring instruments of the moving-coil type, styled the "A.I.C.," which is being put on the British market by the ELECTRICAL APPARATUS CO, of Caxton House, S.W. These instruments have been brought out with the deliberate intention of making them the best in existence, and many new and valuable features have been embodied in their construction. For example, the steel pivots, instead of being conical, in conical jewels, are cylindrical, highly polished, and move in high-class watch jewels; it is claimed that these pivots, unlike the former, remain practically frictionless for many years, and though much more difficult to make, they are free from the risk of damage by shock or vibration. Again, special precautions have been taken to make the cases perfectly and permanently dust-proof, it having been found that dust is the great enemy of delicate movements. All voltmeters are adjusted to a uniform resistance of 100 ohms per volt, so as to be interchangeable in connection with multipliers; all milli-voltmeters for use as ammeters, with external shunts, are similarly adjusted to a uniform resistance of 1 ohm, and give full scale deflection with 50 milli-volts, while the shunts are interchangeable, each of them giving a drop of 50 milli-volts at its rated full load. The resistance material used in the shunts is an alloy which has no thermal E.M.F. with copper, and has a negligible temperature coefficient. The portable instruments are guaranteed for one year to be correct within $\frac{1}{2}$ per cent. of their capacity. One scale division always represents either 1, 2 or 5 units, or decimal multiples, inconvenient factors being avoided.

FIG. 4.—CYLINDRICAL PIVOT, GREATLY ENLARGED.

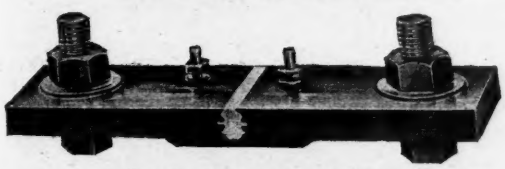


FIG. 5.—500-AMPERE SHUNT.

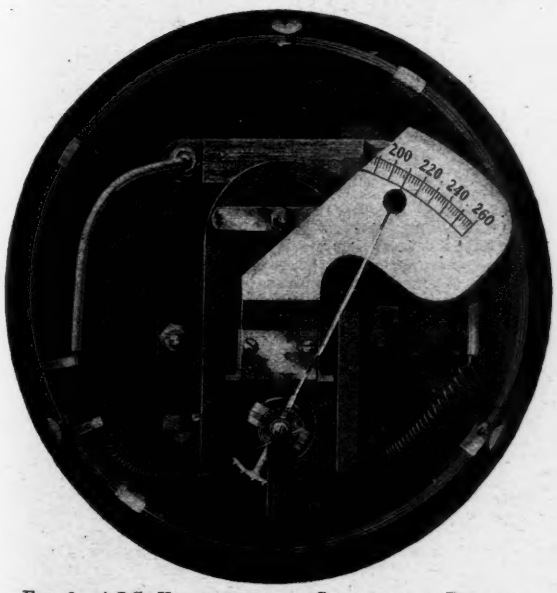


FIG. 6.—A.I.C. VOLTMETER WITH SCALE PARTLY REMOVED.

Fig. 4 shows a cylindrical pivot, greatly enlarged; fig. 5 shows a shunt of 500 amperes capacity; and fig. 6 shows a voltmeter with case removed, and part of the scale cut off to show the interior.

LEGAL.

POSTMASTER-GENERAL *v.* NATIONAL TELEPHONE CO.

As we briefly announced last week, in the Chancery Division of the High Court on Wednesday, March 20th, Mr. Justice Swinfen Eady decided the question relating to private telephone wires, which he had before him a week previously in a special case stated in the action by the Postmaster-General against the National Telephone Co.

His LORDSHIP said the question whether the defendants were accountable to the plaintiff for royalties in respect of the telephone lines mentioned in the first schedule to the special case under Clause 7 of the licence of November 29th, 1884, depended upon whether the communications transmitted thereby were, by virtue of Sec. 5 of the Telegraph Act, 1869, excepted from the exclusive privilege of the Postmaster-General. Two examples might be taken from the schedule as an example of the rest—a limited company carrying on business as theatrical ticket agents had a telephone to 16 hotels, 32 theatres and 2 large stores, and a steamship company that had a telephone line to a limited company, carrying on business as excursion and tourist agents. The telephones were used for ordinary business purposes to the mutual advantage or benefit of the parties at each end of the lines of communication. In the former case the wire was owned or rented by the theatre ticket agents, and in the latter by the steamship company. Were communications made by telephone under such circumstances telegrams transmitted by a telegraph maintained or used solely for private purposes and relating to the business or private affairs of the owner thereof? In his opinion, the words "solely for private use" meant solely for the private use of the owner of the telegraph. In order to fall within this exception, the communications must all relate to the business or private affairs of the same person, the owner of the wire, or including his family and employés; for instance, where two or more departments of the same works were connected by a wire, or a head office and branches, or the proprietor's business and his private house. But where the telegraph was maintained for the mutual business or private affairs of two or more separate and independent persons or concerns, that was not within the exception. The exception protected, by excluding from the Postmaster-General's exclusive privilege, the internal communications between different portions of the same establishment, whether a business or private affairs, but not the external communications between two or more separate establishments. If the argument of the defendants was well founded, the words "private wire" merely meant not open to the use of the public; any number of persons might be connected together by a so-called private wire, and apparently they could also be connected by a private telephone exchange, so long only as none of the telephones were open to the use of the public. Such an interpretation of the Act would practically destroy the monopoly of the Postmaster-General which it was the intention of the Act to confer. It followed from what he had said that he must answer the question in the special case in the affirmative—that defendants were accountable for royalties in respect of all classes of lines referred to in the first schedule to the special case.

RATING OF TRAMWAYS.

(*Concluded from page* 469.)

THE appeal relating to the rating of the undertaking of the Wakefield and District Light Railway Co. was continued on Thursday last week.

Mr. CLAVELL SALTER having followed Mr. LUSH, K.C., on behalf of the appellants,

Mr. RYDE, on behalf of the respondent company, submitted that the judgment of the Divisional Court should be affirmed. If the local authority's contention was right, it would lead to this remarkable result: If the light railway was laid on the company's own land so that they ran unfettered by other traffic, full exemption; but if the line was laid on the surface of the highway and other traffic

hampered the running of the cars, so making the undertaking less valuable, in that case the company was to lose the benefit of the exemption. He submitted that the railway company did not lose their right to the exemption which they otherwise would have, because other people used the land concurrently with the company. To say that the company should be charged in full for water, hospitals and other things, merely because other people shared with the company the right of running over the surface, seemed to him a very remarkable result.

In the result, their Lordships held that the undertaking in question was a railway, and not a tramway, and was entitled to the exemption given to railway companies in Sec. 211 of the Public Health Act, 1875.

The appeal was therefore dismissed with costs.

PARLIAMENTARY.

Rawtenstall Corporation Tramways.

On Tuesday and Wednesday last week the Police and Sanitary Committee of the House of Commons, presided over by Mr. Corrie Grant, were engaged in the consideration of the Bill promoted by the Rawtenstall Corporation, which amongst other matters empowers the Corporation to embark on a somewhat large tramway scheme. Mr. Hutchinson and Mr. Carson appeared for the promoters, and Mr. E. Rhodes represented the Bacup Corporation, who opposed one of the proposed tramways. Sir Ralph Littler, K.C., and Mr. Balfour Browne, K.C., opposed the proposal to run motor-omnibuses, on behalf of the Lancashire and Yorkshire Railway Co.

Mr. Hutchinson first dealt with general portions of the Bill, and pointed out that Rawtenstall was a town of 32,000 inhabitants, and was one of five large towns in somewhat close proximity to each other. To the westward there was Haslingden, with a population of 18,500; then Accrington, with a population of 44,000; to the southward Bacup, with a population of 33,500; and immediately to the north was Burnley, with a population of 97,000. The Rawtenstall Corporation obtained a provisional order for the supply of electricity in 1899, but it was simply obtained as a measure of protection, and there was no intention at that time to immediately commence to supply. The necessity had, however, now become pressing, and especially in conjunction with the tramway proposals. The present Bill practically arose through the application made to Parliament last session by the Haslingden Corporation, who secured powers to electrify the tramway system there. There were steam tramways existing which connected up Accrington, Haslingden and Rawtenstall; and Accrington became the owners of the tramways in their area, and in 1905 obtained power to reconstruct them, and work them electrically. Had Accrington proceeded to do this, it would have meant the severance of their part of the tramways system which now ran through the three towns. In the following session Haslingden obtained similar powers in relation to the tramways in that district, and they also made proposals with regard to the reconstruction of parts of the line in Rawtenstall. As a result of these proposals, the Rawtenstall Corporation agreed to come to Parliament in 1907, for power to reconstruct the tramways in the Borough, and work them electrically. In pursuance of that pledge, they came for power to enable them to work the tramways in conjunction with Haslingden and the other authorities to the westward, and also to construct certain other tramways.

The Mayor and Town Clerk having given formal evidence as to the population and rateable value of the district,

Mr. Hutchinson proceeded to deal with Part II of the Bill which proposed to enpower the Corporation to reconstruct certain tramways, now the property of the Accrington Steam Tramways Co., and the Rossendale Valley Tramways Co. The proposals included the reconstruction of a tramway in the area of the Bacup Corporation, which it was stated that body showed no disposition to deal with.

The Chairman: You have given notice formally to purchase, and you are asking under the Bill for power to work?

Mr. Hutchinson said that was so. It had been arranged that the purchase by the Rawtenstall and Haslingden Corporations should take place together. In their Act of 1887, the Corporation had special powers to purchase any tramways running through their district, but if such tramways were acquired before 1907 they were under an obligation to lease them. As they had not previously purchased the tramways, the obligation to lease fell through.

The Chairman: And I suppose there is some arrangement between the authorities for working.

Mr. Hutchinson said there were definite arrangements between Haslingden and Rawtenstall, and he believed there were arrangements between Accrington and Haslingden. He thought there would be a continuous service between Accrington on the west, to Bacup on the east. With regard to the portion of tramway in Bacup, the position was that the Bacup Corporation had powers to purchase. The Rawtenstall Corporation were proposing to purchase the tramway, and the owners were not objecting, and the object was to benefit the whole of the district.

The Chairman: As I understand, Rawtenstall is going to take what you call the Rossendale Valley Tramway. That is not only towards Bacup, but towards Crawshaw Booth. You propose to extend it from Crawshaw Booth to the boundary of the borough; to electrify the whole of it, and if you get power, to electrify it from Rawtenstall to Bacup.

Mr. Hutchinson: Yes.

The Chairman: And the result will be that you will have an electric tramway from Accrington to Bacup.

Mr. Hutchison said that that was so. Their proposal would link up the whole of the tramways into one communication, from Accrington on the west to Bacup on the east.

Local evidence was then called in support of the Bill, and the chairman intimated that the parties might come to some agreement.

On Wednesday March 20th, Mr. Rhodes, for Bacup Corporation, said no arrangement had been come to with regard to the possession of the trams.

Mr. Hutchinson, K.C., said his clients were willing to allow Bacup Corporation the right to obtain the trams on the understanding that should the Committee grant Bacup Corporation the power, a clause should be inserted in the Bill stating that should the Corporation not purchase the trams within a given time, Rawtenstall Corporation should have power to obtain the trams.

A discussion ensued as to whether the Bacup Corporation, if they purchased the trams, could electrify them. Mr. Rhodes maintained they could, and pointed out that even as late as 1902 Bacup showed a desire to obtain the trams as soon as possible, for they then agreed with the existing company to be able to buy the trams after the expiration of 21 years from 1882, and not from a later date.

Mr. Hutchinson, K.C., quoted clauses to show that Bacup could not, even if they were able to electrify them, purchase the trams until 1909, and not 1907, as they now said they could. After further discussion, Mr. Hutchinson admitted that Bacup had got power to electrify. Continuing, he said that he could quite see that Bacup Corporation wanted to retain their tramways, but if they kept them the continuity of service would be prevented. In the event of the trams being purchased by Bacup, he asked that the Rawtenstall Corporation should be granted running powers over the Bacup tramways, subject to such payments as might be determined by arbitration or the Board of Trade. Should Bacup at the end of seven years want to run cars over Rawtenstall lines, Bacup should be allowed to apply to an arbitrator as to the desirability of their being able to run cars, all questions relative to the payment, &c., to be made to Rawtenstall Corporation.

Mr. Rhodes protested against the inclusion of the clause dealing with the line when they should apply to Parliament for powers to obtain possession of the trams, as they were already in negotiation with the Rossendale Tramway Co. for purchasing the trams.

Mr. Corrie Grant (chairman) pointed out that the clause was only an enabling clause and not a compulsory clause.

Mr. Hutchinson, K.C., said that the termination of Rawtenstall Corporation running powers should rest with the arbitrator at the end of every recurring seven years.

After further discussion, Mr. Rhodes said that the Bacup Corporation would reconstruct and electrify the tramways within three years, if Rawtenstall would take them on a lease on such terms as would pay for the expenses incurred.

Finally, it was agreed that Bacup should acquire the tramway in question, and reconstruct and electrify it, and then lease it to the Rawtenstall Corporation for 30 years, on the terms of the Rawtenstall Corporation paying to the Bacup Corporation all the expenses incurred by them, including the interest on the loan which they will have to raise for the reconstruction of the line.

The Committee passed this portion of the Bill, and then proceeded to deal with Part III, giving the Corporation power to run motor-buses in and outside the borough.

Radio-Telegraphic Convention Committee.

Sir J. Dickson-Poynder's Select Committee on the Radio-Telegraphic Convention held its second sitting on 21st inst., when Mr. Babington Smith, secretary of the General Post Office, was cross-examined.

Answering Mr. Lambert, Witness said he was appointed secretary to the Post Office in October of 1903, and had seen the whole of the negotiations going on with regard to wireless telegraphy since that time. The position taken up in February, 1904, at the conference of the First Lord of the Admiralty, the Postmaster-General and the President of the Board of Trade, and which had been quoted, had remained consistently the policy of the late Government and the present Government. The only alteration made was that after further consideration, certain stipulations and safeguards were added by the desire of the Admiralty. Both Governments considered the question, and came practically to the same conclusions as he had shadowed forth in his evidence. They had a Postal Convention and a Telegraphic Convention, and his idea was that this Convention would follow on somewhat the same lines.

Mr. Lambert: Supposing the Telegraphic Convention should be broken, what would happen?—The result, I think, would be general chaos, and a very serious inconvenience to the international telegraph service. In the case of the telegraphic system which has existed so long, certain principles and methods are established which might continue even if the union were dissolved; but in the case of a wireless service, which is only coming into existence as an international service, and to which no fixed principles are at present laid down, and, moreover, where there is a special problem and difficulty (I mean the problem of interference) which does not arise in ordinary telegraphy, I consider the results would be likely to be found more inconvenient and detrimental to national interests.

Questioned by Mr. Lee, Witness said he considered the Convention would be advantageous to British interests, and that was his opinion before he went to the Conference, providing that it was possible to modify the draft Convention in the manner in which they were instructed to modify it. He thought the draft Convention in its original form was open to serious objections, and had the Convention remained in that form he would have considered it undesirable, and in that case they would not have signed the Convention. The general gist of the instructions to the British delegates was to support the Convention if modified. He thought that Great Britain, including the Empire, had greater interests at stake than other countries, and no country had need of such an efficient service for war purposes.

Mr. Lee: Would not Great Britain surrender the unique advantages she possesses from being first in the field and by view of her geographical position?—No; I think the opposite. If we were to refuse to ratify, with the intention of declaring for a policy of non-intercommunication, the result would be to sacrifice the advantages which the British Empire possesses from its geographical position. If the stations put on British territory were not freely open to the ships of the world, there would be not only an inducement but the necessity for other countries to erect stations which would be open to intercommunication. If we close our coasts except to a single system, a complete set of stations will be established on the opposite coast, and these would not only take the traffic from us, but would block our service.

I presume the Post Office consider that if the Convention is ratified it will relieve them from dependence to their present extent upon the Marconi Co.?—I do not think the Post Office at present at all depends on the Marconi Co.

To the extent of their agreement with the company?—The agreement does not in any way place the Post Office in dependence on the company.

It places on the Post Office certain obligations which would be removed if the Convention were ratified?—No. The obligation of the Post Office would be in no way modified. The agreement is to afford facilities for intercommunication and to license certain stations, and these obligations exist whether the Convention is ratified or not. The Convention would relieve the Admiralty and Lloyd's, as barring the Marconi Co. from any claim to compensation on the ground that they were bound to accept the provisions of the international Convention. The Post Office is under no obligation whatever not to intercommunicate with any other stations.

The result of ratification would not be to involve the Government in the necessity of granting compensation to the Marconi Co. for any violation of the existing agreement?—I think not. One of the objects of the agreement was to bar any such claim for compensation.

Continuing, Witness said it was possible that the Marconi Co. might raise a claim, and he believed it was their expressed intention, but in his opinion there was no ground for such a claim.

Sir Edward Sassoon questioned witness as to what the attitude of the British delegates to the Convention was as regarded the patent rights in this country.

Witness said they raised the question as regarded patent rights generally, and it was decided that no such injury would arise. Practically, he supposed the Marconi Co. would have to give intercommunication at their stations if the Government desired it, or the stations would cease to exist.

Col. Davies, Assistant Quartermaster-General of the Western Division, one of the British delegates to the Berlin Conference, gave evidence respecting the views of the War Office on the Convention. He stated that in the opinion of the War Office the Convention did not contain any objectionable provisions, and it was equally confident that the development of wireless telegraphy would be impeded if Great Britain decided to remain outside the Convention.

The Committee adjourned.

North-East London Railway Bill.

An important point was raised before Mr. Emmott's Committee of the House of Commons on Unopposed Bills on Friday in connection with the Bill of the North-East London Railway Co., by which it was sought to get a further extension of time for the purchase of lands; to extend the time for the raising of capital; and to raise the interest to be paid out of capital during construction from 3 to 4 per cent.

Mr. Cameron (Parliamentary agent) appeared for the promoters, and explained that the Act authorising the construction of the railway was passed in 1905. The line was to go from the Monument to Waltham Abbey and to Walthamstow. By the first Act they were authorised to raise £3,000,000 capital, and by a Bill of 1906 they were authorised to raise an additional £250,000. They were empowered to pay 3 per cent. for three years' interest from capital during construction.

The Chairman: The clause is, that the amount to be paid in interest shall not exceed £300,000.

Mr. Cameron said the Act was not to take affect until they had raised half of their capital, and they were asking for further indulgence in this respect by getting an extension of two years. The clause was put in at the instance of the London County Council and the Corporation of London, and neither of those bodies offered any objection to the extension.

Mr. J. Bevan Braithwaite was called, and said that this time last year his firm had almost completed arrangements for the issue of capital. Unfortunately he met with a serious motor accident and was incapacitated from his business for about eight months, and as the whole thing was in his hands it stood over. The high Bank rate that had prevailed had made the raising of money for a railway where the interest was only 3 per cent. during construction a difficult matter, and he thought it necessary that the interest should be raised from 3 to 4 per cent. They were at present engaged in serious negotiations with parties who held out a fair prospect of raising the capital, but they lacked bearer certificates which could be more easily negotiable. In France and Belgium, and other countries where they found a great deal of capital for this sort of undertakings they did not register shares, but only shares to bearer.

Mr. Cameron said there were two or three precedents in the Electric Power Bills for issuing shares to bearer.

The Chairman: The Committee have to decide what they are going to do about this, and we would like to know if any capital has been raised.

Witness said that none had been actually raised, as it was necessary to raise not less than £1,500,000 or £2,000,000. All their negotiations had been directed to raising not less than £1,500,000 share capital, and an amount of debenture stock. No prospectus had been issued to the public.

The Chairman: Some people must have found a good deal of money. If there is no money in the form of share capital, will any interest be paid on the money found up to the present?

Witness said he understood that was to be the case, but he was not a promoter.

The Chairman said that if, for instance, £100,000 had been raised, it would mean a lot of interest being paid to the promoters if there was a further extension of time.

Mr. J. T. Middleton said he was one of the promoters, and had found about £20,000 of money on condition that a contract was entered into with his firm for construction as set out in the original Bill. There was an arrangement as to arbitration, so that his firm could not charge too much. They had share certificates for the £20,000. They were getting no interest on that, as no capital was raised, and they would get no interest on it until other shareholders obtained interest. They were to receive one-third of the contract price in shares.

The Chairman: It is an extraordinary thing to come last year and ask for one year to raise the money, and now come and ask for two years. I can assure you that this will be an important question in this or other Bills. If we are asked to give a higher rate of interest we must ask about promotion expenses.

Witness suggested that if a clause were inserted that no interest was to be paid on the promotion expenses until other shareholders received interest, that might meet the case.

Mr. Braithwaite, recalled, said the reason why they asked for two years was this. What he might call the Speyer system of railways would be completed when the Charing Cross, Euston and Hampstead Railway was completed. Their system had been designed as a complete railway, and they said it was not fair to judge of their system until the whole of it was completed. As they knew at present, the results of a portion of their system had not been so satisfactory from the shareholders' point of view. That being the case, English investors were a little disposed to look rather shy on these tube railways. In the North-East London Railway the conditions were different, as only 4 miles of the railway was tube and 11 miles in the open, and personally he felt it would have better financial results than any other London tube. If their negotiations for raising the capital abroad and raising it in New York failed, he did not think the British public would be disposed to invest money in tubes until they made a better show than now.

The Chairman: Are we dependant much on foreign capital for these things?—We have not done so hitherto. The foreign tubes are doing more than ours, for they have more confidence in electric railways then we have, and under these circumstances we are likely to get capital from abroad.

Is the Paris Tube railway doing well now?—Yes, and they look with a rather more favourable eye on these things than the British do at this moment.

The Committee deliberated in private for some time, and the Chairman announced that the extension of time for the purchase of land would be granted, and they were willing to give another year for the raising of capital, but they could not grant an increase of interest to be paid from capital during construction. They had no objection to granting certificates to bearer.

Mr. Cameron said they had better defer the consideration of the clauses.

The Chairman said they would like the matter to be carefully considered and to have the clauses brought up at their next sitting after Easter.

Richmond (Surrey) Electricity Supply Bill.

This Bill came before Mr. Hutton's Select Committee of the House of Commons on Friday. Mr. Moon, K.C., and Mr. H. Lloyd, K.C. appeared for the promoters, the Richmond Electric Lighting Co., and Mr. Courthorpe Munro represented the Richmond Corporation, which was opposing.

Mr. Moon said the object of the Bill was to confirm an agreement made in 1891 between the promoters and the Richmond Corporation, and to ratify what had since been done under that agreement. When the agreement was entered into both parties thought the Corporation had powers to enter into it, and after it was completed a company was formed to carry it out, and that company had spent £120,000 in carrying out its obligations, subject to the approval of the Richmond Corporation. In 1905, however, a case came before the Courts which raised the question, on a similar agreement, whether a local authority had the power to enter into such an agreement, and the Court held that it had not

and accordingly it became necessary for them to promote a Bill in order to cure the defect which had never been suspected when the agreement was entered into, in the year 1891. The history of the supply to Richmond was this:—In 1883 a provisional order was obtained under the Electric Lighting Act of 1882 by the Vestry of Richmond. Nothing was done till 1891, when the Board of Trade were threatening to revoke the provisional order. In the meantime Richmond was incorporated, and in 1891 the Corporation entered into an agreement with Messrs. Latimer Clark, Muirhead & Co., and one of the terms of the agreement was that this firm should form a company within two years to take over the order and carry it into effect. The company was formed, and the rights of the Corporation were transferred in 1893. Mr. Moon proceeded to deal clause by clause with the agreement, and pointed out how stringent were the conditions to secure the supervision of the undertaking by the Corporation. Conditions were inserted that the works carried out should be subject to the supervision and approval of the Corporation's engineer, and the maximum charge was fixed at £3 10s. per 100 units, which worked out at 8d. per unit. The company were to keep their accounts separate, and these accounts were to be subject to the audit of a person appointed by the Corporation, and when a dividend of 10 per cent. had been reached, then half of the remaining profit was to be devoted to reducing the price to the public. It was also provided that the Corporation should have power to purchase at the end of 30 years and at the end of every subsequent 5 years, so that it would be seen that it was a limited concession which expired in 1921 and had only 14 more years to run. Under this arrangement the company had expended £120,000 upon the undertaking with the approval of the engineer of the Corporation at every step. It was not a very successful venture. For the first four years no dividend at all was paid; in the fifth year 3 per cent. was paid; for the next two years 4 per cent.; for one year 5 per cent.; one year 6 per cent.; and for the last 5 years 7 per cent. That, however, had been paid on a very small capital of £30,000, and the rest of the money expended on the undertaking had been advanced on temporary loan at interest of 4½ per cent. The decision in Court which necessitated the application to Parliament, affected other companies, and last year there were two Bills passed ratifying somewhat similar agreements—namely, those of Twickenham and Folkestone. It would have seemed that the Corporation of Richmond would have assisted the company in making this application, but they were opposing, and there was no doubt that their opposition was based upon the idea of getting a better bargain. While he was prepared to meet the allegations of the Corporation both with regard to the price charged and the efficiency of the service, yet it did seem to him that it was going rather far for the Corporation to now try and get behind an agreement which they were eager to enter into in 1893. The Corporation in their petition alleged that the undertaking had not been conducted with due regard to the requirements of the consumers, and that the terms of the agreement were not such as would be approved by the Board of Trade at the present time, even if they would have been approved at the time the agreement was entered into. They alleged that the works established by the company were inefficient, and the charges made were excessive and unreasonable. Well, he had the report of the Board of Trade, and they made no objection to the terms, and if it was true that the works were inefficient, the agreement made provision for forcing the company to fulfil their duty. The company were bound to observe the regulations of the Board of Trade, and were subject to penalties if they did not, but no one had ever tried to get a penalty against them. As to their charges, they began at 7d. and were afterwards reduced to 6d., and in 1905 the maximum charge was 5½d. While the charge might seem high as compared with some other places, they had to take into consideration the circumstances of the district. In Richmond they had a place with few new houses being built, and they had no public lighting. He submitted that the Corporation, by their opposition, were simply seeking to get a better agreement, and having regard to all the circumstances of the case, he trusted the Committee would not alter the terms of the agreement.

Mr. H. B. Renwick, secretary and manager of the company, gave evidence in support of the Bill.

Mr. Balfour Browne, K.C., maintained that the agreement of the company was invalid, as it had not had the consent of the Board of Trade, and intimated that if the company would withdraw their Bill, the Corporation would grant the company a lease of the works for a period of 15 years, subject to the confirmation of the Board of Trade.

Mr. Sidney Morse (solicitor to the company) having given evidence as to the legal decision which necessitated the company coming to Parliament,

Mr. Balfour Browne, K.C., addressed the Committee, and said that the transferring of the works in 1893 was absolutely illegal, inasmuch as the Electric Lighting Act of 1882 expressly stated that no works, powers or transfer of any property belonging to a local authority could be made without the consent of the Board of Trade. The action of the company in coming to Parliament was absolutely illegal, as they sought not only to make valid an illegal action, but if the Bill was passed it would confer further powers upon them when, as a matter of fact, they should get the consent of the Board of Trade. The promoters could, if the Bill was allowed to proceed, obtain a bulk supply from London during the next 15 years, and at the end of that time, when the Corporation entered into possession of their works, they would be fit for nothing but scrap iron, or, even worse, they might still have to keep on taking their electricity supply from the company that would be then supplying the promoters. The offer of the Corporation was that they would let the company have the works for 15 years, and at the end of that time the Corporation should have the right to purchase them back. If the Committee granted the company the powers they now asked, they would be going behind the backs of their opponents. The company should have gone to the Board of Trade, and not come to Parliament, for the Board of Trade would have inquired into the affairs of the company, and if the existing rates now charged by the company were excessive they could have revised them. If the Committee passed the Bill they should also inquire into the affairs of the company. Why was the consent of the Board of Trade necessary? The Board of Trade when granting powers looked after the interests of the people. The two cases referred to—at Folkestone and Twickenham—were not the same. In both cases the consent of the Board of Trade had been obtained before the transference of the powers. He submitted that, therefore, those cases were not analagous. In conclusion, he offered to let the company have the existing works for a term of 15 years subject to the consent of the Board of Trade, who would make the terms regarding price and everything relating to the supply, &c.

Mr. Moon, K.C., replied that they would accept the proposition of the Corporation to take the works for 15 years, but they would not agree to the proposal to go to the Board of Trade and have the price fixed.

Mr. Munro said he understood Mr. Balfour Browne to say that they should go to the Board of Trade in the interests of the people, and that was the Corporation's object. If the Committee passed the Bill, the company would be able to go outside the borough to London for a supply, and their works would become scrap iron.

After deliberating in private, the Committee announced the preamble of the Bill proved.

Mr. Munro applied to the Committee to strike out the clause relating to the company being able to obtain a bulk supply inside the area, and to supply power outside the borough.

Mr. R. C. Moon asked Mr. Munro to bring up his suggested alterations and additions to the clauses on Tuesday, when it was agreed to consider the clauses.

Barnsley, Wombwell and Wath Tramways Bill.—The Lord Chairman of Committees has intimated that the promoters of this Bill have notified their intention not to proceed with the measure this session. The proposal was to incorporate a company with a capital of £144,000 to construct about 12 miles of tramways in the West Riding of Yorkshire.

Overcrowding on the Baker Street and Waterloo Railway.—In the Parliamentary papers, Mr. Bridgeman asks the President of the Board of Trade whether his attention has been called to the overcrowding on the Baker Street and Waterloo Railway at the busy times of morning and evening, and whether, seeing that it is largely due to the fact that the company runs trains of three coaches only, he will take steps to induce the company to revert to four-coach trains during the busy times of the day.—Mr. Kearley, in reply, states that the railway company has informed the Board of Trade that it has been decided to return to a service of six and four-car trains instead of the three-car service now running.

Electric Supply Bills.—In the House of Lords last week, the Earl of Onslow moved that the Electric Supply Corporation Bills (Nos. 1 and 2) be not further proceeded with, and that leave be granted to the promoters of the Bills to present a Consolidated Bill in lieu thereof. This was carried.

THE VERITY-DALZIEL SYSTEM OF TRAIN LIGHTING.

The system of train lighting described below is the invention of Mr. J. Dalziel, Assistant Engineer to the Locomotive Superintendent of the Midland Railway.

It consists of an ordinary shunt-wound dynamo for supplying energy when the train is in motion, a single battery for taking over the lighting during stoppages or for supplementing the dynamo on occasion, and a small auxiliary pressure-regulating machine and switchbox, the latter containing automatic switchgear. The train lamp voltage is 50. The battery, on account of its limited functions, is much smaller than with the constant current arrangement, where it has to bear the brunt of the regulation and may be frequently either over or under charged; as its capacity may be for three or four hours' storage only, its first cost and weight are both reduced.

The generator (fig. 2) is of normal type, for slinging under the coach and belting to an axle pulley; it is fitted with an antomatic reversing switch for changing the connections when the travelling direction of the coach is reversed and so ensuring uni-direction of current. It weighs from 1½ to 2 cwt. and gives its normal voltage at about 400 R.P.M. The regulating machine is a booster combination consisting of a motor, controller and exciter on one

spindle; each armature rotates in its own field and the three fields have a common yoke in the box casting (fig. 3) containing the complete machine. This apparatus weighs about 1 cwt. and may be fixed anywhere under the coach, as it is driven electrically from the generator.

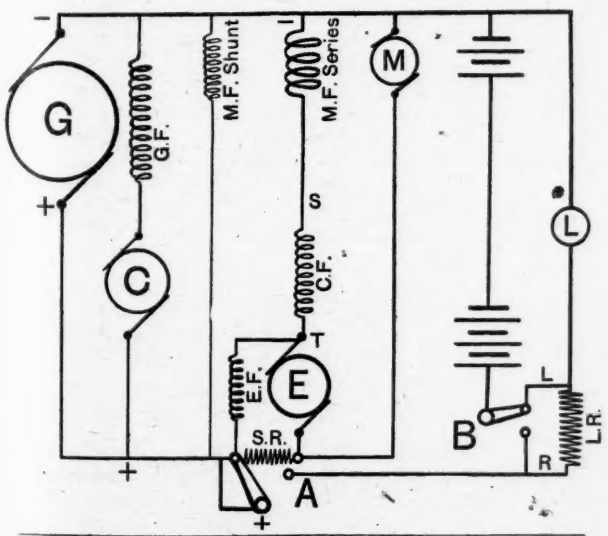
Referring to fig. 1, which represents approximately the arrangement of the system, it will be seen that each regulator armature has a shunt field, and the motor has, in addition, a series field energised through the exciter armature. The motor armature and its shunt field are directly across the mains, and the controller armature is in series with the main generator shunt field.

The main generator pressure is approximately 58 volts, and the exciter, which has a highly saturated field, gives approximately 56 volts pressure; and as these oppose each other across the controller field, it is evident that with pressure fluctuations, the controller armature may revolve in either direction, and so vary the strength of the main generator field—reducing it when the generator pressure is above the normal or exciter pressure, and assisting it in the reverse case. Further, the series field in the regulating motor (energised by the exciter) becomes stronger with increase in train speed, and this reduces the speed of the regulating combination and the pressure of the exciter, thus increasing the controlling effect.

The switch box (fig. 4), measuring 15 in. × 15 in. × 6 in., which can be fixed in any convenient position, contains solenoid-operated switches for controlling the charge and discharge of the battery and the supply of energy to the train lights.

The actual operation of the system is as follows:—

It will be seen from fig. 1 that the generator and regulating portions of the system are isolated on one pole,



Generator	G	Generator Armature.	Accumulators	-||||-	One Battery of 25 cells.
	GF	Generator Shunt Field.		Ⓛ	Lights.
Regulating Machine	M	Motor Armature.	Wiring and Installation	L	Lights Main.
	MF	Motor Field.		R	Resistance Main.
	E	Exciter Armature.		LR	Lights Resistance.
	EF	Exciter Field.		+	Dynamo Lead.
	C	Controller Armature.		—	Return Main common to Entire System.
	CF	Controller Field.			
Automatic Switches	A	Generator Switch.			
	B	Battery Switch.			
	SR	Motor Starting Resistance.			

Fig. 1.—Diagram of Connections, Verity-Dalziel Train-Lighting System.

and that the battery is supplying the lights direct. The switches A and B are retained by gravity in the positions shown, but switch B is held down electrically in this position by the battery discharge current for a purpose which will be described later.

On the train starting, the reversing switch on the generator (not shown on fig. 1) is automatically turned over, if necessary, to secure the correct polarity with the train direction.

The generator self-excites and supplies current through the controller armature to its own shunt field, to the motor-shunt field, and through the starting resistance S R to the motor armature, thus enabling the regulating machine to run up to speed as the train speed and the generator voltage increase.

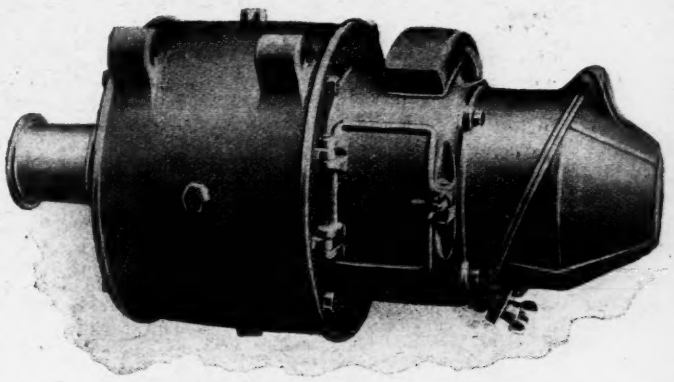


Fig. 2.—D.C. Generator, Verity-Dalziel Train-Lighting System.

The voltage speedily rises, and at a train speed of about 15 miles per hour reaches approximately 45 volts. At this voltage the switch A has been adjusted to operate, and on rising it short-circuits the starting resistance, and connects the generator to the lights and battery through the resistance L R. The immediate effect of the closing of switch A is that the exciter generates, and current flows in the exciter circuits in the direction, — S T E +.

The controller field is therefore excited in the direction which causes the controller to boost up the voltage on the generator field winding, which in turn raises the generator voltage to 55. The dynamo now begins to supply current through the resistance L R to the lights.

When the voltage has risen to 57 or 58 the dynamo is supplying all current to the lamps through the resistance L R which drops about 7 volts, and no current flows from the battery. The switch B now operates (being no longer held down by any battery discharge current) and turns the battery over to the dynamo direct. The dynamo continues

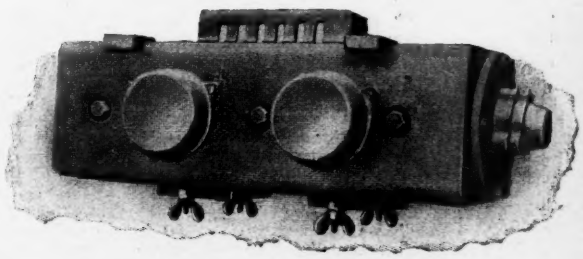


Fig. 3.—Verity-Dalziel Regulating Machine.

to supply current to the lamps and now also gives a steady current to the battery, which current will gradually decrease as the battery becomes more fully charged.

The switch B rises at a train speed of from 17 to 18 miles per hour, and as the dynamo is then supplying the lamps, no perceptible flicker in the light takes place. Between the closing of switches A and B the exciter becomes a motor, reversing the controller excitation, which therefore boosts down the voltage on the generator field.

As the train speed further increases, the motor current through the exciter circuit rises, and by means of the motor series coil strengthens the motor field, thus reducing the speed of the regulating machine, and standard voltage of the exciter; the current through its circuit is increased and the controlling effect is further increased in such a

manner as further to boost down the generator field voltage, thus maintaining a steady line voltage.

The line voltage variation between the minimum and maximum train speeds after the closing of B switch is so small as to be imperceptible.

As the train speed decreases, the sequence of regulation takes places in the reverse order, and a critical speed is ultimately reached at which the dynamo, in order to generate its standard voltage will require little or no negative boost to its field G F. There will then be insufficient voltage across the armature C to maintain the switch B in a closed position, and this switch falling connects the battery direct to the lights. A still further decrease of train speed releases the switch A, which drops to its original position. The battery alone now supplies current to the lights.

The magnet D, in the switch box fig. 4, is excited by the battery discharge current, and performs the double function of (1) holding down the switch B while the battery is discharging, releasing it when the current falls to zero in a starting train, thereby preventing disturbance in the lights, and (2) in the event of an over-discharge of the battery

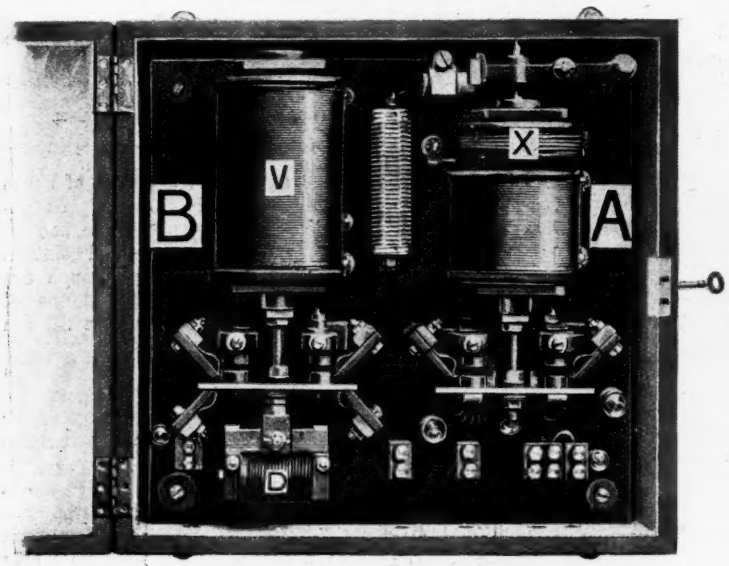


Fig. 4.—Switch Box, Verity-Dalziel Train-Lighting System.

(which may take place owing to the lights having been left on in a disused train), holding down the switch B with the charging current which will pass to the battery through the lamp resistances until the battery has recovered itself to such an extent that it will not take an abnormally heavy current when it is connected direct to the dynamo.

The series coil X on the switch A is excited by the total dynamo current, thus giving to the solenoid increased holding power on top load. The coil V on switch B is excited by the voltage across the controller armature, and, therefore, has an increased holding power at top train speeds. The switches are, therefore, totally unaffected by train vibrations.

The higher pressure employed—viz., 50 volts, as compared with the usual 24, enables a reduced size of wiring to be used, and is adapted for metallic filament lamps.

We understand that the system has been actually run in service for some time with the greatest success.

THE PATENTS AND DESIGNS BILL.

It is now generally admitted that the encouragement of invention by good patent laws exerts a highly beneficial influence on the industrial development of a country. This country is the original home of patents for invention, though other countries, such as the United States of America and Germany, followed our example, introducing Patent Laws containing many improvements on the parent system. Within the last quarter of a century we have been bestirring ourselves to make up lost ground. The Patents Designs and Trade Marks Act, of 1883, simplified procedure and greatly reduced the cost of patents, but still left the question of the novelty of the patented invention untouched, though we had the experience of the United States and Germany to show how much benefit all parties concerned could derive from an official investigation as to novelty before a patent was granted. The Patents Act of 1902 partly remedied this defect of our Patent Law by instituting a search for novelty, but failed to reach the ideal, because it made no provisions for the refusal or compulsory extinction of patents wanting in novelty. This still left a door open for the privateer patentee who desired to have a legalised monopoly, to enable him to prey upon the poor manufacturer who was afraid to run the risk of an expensive lawsuit, and would prefer to pay a royalty for his right to carry on a manufacture which was already public property.

The Patents and Designs Bill, introduced to Parliament by the President of the Board of Trade last week, proposes to obviate some of the remaining defects of our Patent Law, though, we regret to find, it contains some provisions of doubtful economic value.

The procedure proposed for the extinction of patents wanting in novelty is somewhat different from that adopted in the United States and Germany, but it appears that it may be none the less effective. The patent wanting in novelty is not to be refused by the examiner, but it may be refused by the Comptroller on opposition proceedings, or it may be revoked by the Comptroller after it has been granted if any party concerned can show that the invention has been previously described in a prior specification, or in any other publication in this country. This is an important extension of the former ground of opposition, which was restricted to publication in prior specifications. It gives the person who is asked to pay royalty on a patent for an invention, which he is convinced is wanting in novelty, the opportunity of obtaining relief in the Comptroller's Court, where the expenses need not be heavy. There is an appeal from the Comptroller's decision to a judge of the High Court, selected for the purpose by the Lord Chancellor, but the decision of this judge is final. The Comptroller may also revoke a patent if it is shown that the invention is insufficiently described.

These provisions for revocation will still leave in existence a number of invalid patents which are left alone either because they are not used for privateering purposes, or because the persons preyed upon are unwilling to apply for relief, or are ignorant of the procedure for obtaining it. It remains to be seen whether any real grievance will be left on this account. The extinction of a patent by revocation has the advantage over refusal by an examiner, that the investigation will be confined to fewer cases, and will be made in open Court after hearing all parties.

Besides these grounds for the revocation of a patent, which are unquestionably legitimate, the Comptroller may, according to the new Bill, revoke patents on grounds which are very questionable from an economic point of view.

In Clause 10 of the Bill it is provided that "At any time less than three years after the grant of a patent, any person interested may apply to the Comptroller for the revocation of the patent on the ground that the patented article is manufactured exclusively or mainly outside the United Kingdom."

This provision is apparently in the interests of British manufacturers, though that is doubtful, but undoubtedly it is opposed to the interests of British consumers. The patentee who manufactures his patented article abroad, presumably does so because he can manufacture it more cheaply at one large central factory, where probably labour is cheaper and raw material more accessible. This provision in the new Patents Bill, if it become law, will compel him to

start a second factory in this country, thereby increase his working expenses, and raise the cost of the article to the consumer. If the patentee finds that he cannot profitably establish a second factory in this country his patent will be revoked. This, of course, will leave it open to our manufacturers to manufacture the new invention without payment of royalty, and, under these circumstances, they may be able to manufacture profitably. But is this honest?

The economics of Patent Law appear to have made no progress since the time of James I. The object of patents at that date was to introduce the manufacture of the patented article into the country, and that was looked upon as the consideration which the State received for the temporary monopoly which was granted. But the knowledge of the manufacturer can now, in our advanced state of technical knowledge, be communicated by the specification, without personal instruction by persons skilled in the art. We have no need, therefore, to bring over the foreign manufacturer to teach us how to make his new invention. We want his patented article at the lowest price at which he can produce it, and if he can make it cheaper at home than he can do in this country, it is to our interest to let him do so.

The provisions to compel foreign patentees to manufacture their inventions in this country appear to have been introduced under some vague idea that British industries would otherwise be obstructed. But it is difficult to see how this could happen, unless the foreign patentee refused to supply the patented article at all, or only at a prohibitive price to the user in this country who required it to increase the efficiency of his business. Such a contingency as this was provided against in former Acts by the requirements as to the adequate supply of the public with the patented article. These requirements as to the adequate supply of the reasonable demands of the public are amended in the new Bill, and appear to be quite sufficient to secure to the public an ample consideration for the grant of a patent to the foreigner, without any vexatious condition as to the manufacturing of the patent in this country when it can be made more cheaply abroad.

There are several minor amendments in this Bill, which are evidently the outcome of the experience of the Patent Office in carrying out the former Acts, and which, no doubt, will be of great value when the Bill becomes law. For example, power is given to the Patent Office to ask for samples of new chemical substances, thereby ensuring that claims will not be made for substances that have never been produced.

In every respect, except as to the vexatious condition of compulsory working, the Bill appears to be a decided advance in the right direction.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Prestwich Union Specification.

I have just noticed the letter above the signature of "Disgusted" in connection with the specification at head, and really cannot see the cause for grumbling.

In the majority of cases plenty of scope is given, as he himself points out (such as four firms for the accumulators), and I have little doubt but that competition between the manufacturers named will be most severe. In the few cases in this specification where only one firm is mentioned, the prices are standard, and the goods, in the opinion of most experts, the best manufactured. As a matter of fact, the writer's firm represents two well-known houses whose names are not mentioned, but, on seeing the consultants, was at once assured they would be considered on the same plane as the several people specified; this allowing us to quote several contractors with some hope of securing the orders.

"Disgusted" must surely admit that for important installations of this description it is imperative that all the plant and various materials should be of the best and by the leading manufacturers; it is obvious that this must reduce the risk of breakdown, and there is no difficulty in obtaining spare parts.

In regard to the responsibility for work carried out by sub-contractors, there is no difficulty in this connection, as it is usual for the contractor to place the orders for all plant under the same terms as he himself is bound by, thus covering himself against loss; this also applies to the penalty for late completion, so far as all the plant is concerned. There must be some penalty clause inserted by the Consultant, in justice to his clients.

H. A. Jackson Co.,
A. Rowell Young.

Salford, *March 22nd*, 1907.

There are many things in favour of a consulting engineer specifying the productions of Messrs. Tom, Dick & Harry, particularly if their manufactures are of first-class quality.

The consulting engineer knows that he can place reliance on such goods, usually from long acquaintanceship and good service in the past. He wishes to give his client the best obtainable, and at the same time to enhance his own reputation.

In these days, when the lowest tender is almost invariably accepted, and occasionally leads to scamped work, it must be some satisfaction to the consultant, and relieve his mind of some anxiety, to know that the manufacturers of the material can be depended on.

Surely "Disgusted" has heard, and often put into practice, the old saying, "If you pay the piper, you can call the tune." It is just possible that the consultant may have been bitten by the cheap-priced man before, and has learnt a lesson never to be forgotten.

Even with Messrs. Tom, Dick & Harry's material specified, cases are common enough where inferior articles of Messrs. Shoddy & Co.'s manufacture have been substituted, on the "just as good" argument, sometimes with the consulting engineer's approval, after pressure by the contractor (a course obviously unfair to other tenderers), but usually without his knowledge.

This is the other side of the question, and as a sufferer I am able to say I am

Also Disgusted.

Reunion of the E.E.R.E. (Vols.).

As we have had the good work done by the E.E.R.E. (Vols.), both at home and abroad, before us lately, I suggest that, if possible, there should be a re-union of all active service members in the form of an annual dinner or social. No doubt many late members would be glad to meet their old comrades again.

I should be glad if other members would give their views on this matter.

Late A.S. Member.

State Salary Required.

I notice in your issue of March 22nd a letter under this heading by "P. O. W." I should be glad if you would allow me to express my agreement with the views of your correspondent.

The present system of competitive tendering for contracts for works is not all that could be desired, but the system of advertising vacancies for situations described by "P. O. W." is a great deal worse. In this case, not only are the majority of advertisers extremely vague concerning both their identity and the exact qualifications required, but they have not the candour to refuse to bind themselves to accept "the lowest or any offer."

In the opinion of the writer, it would be better if the advertisers, instead of getting a man at the lowest possible salary, were to state what they were willing to give, and get the best man for that salary.

G. W.

Surging of Currents in Networks.

It would be interesting to know if any of the breakdowns on networks can be definitely assigned to the transient rise of pressure which occurs when a short circuit takes place.

A great deal has been written on this subject from time to time, and recently C. Feldman and J. Herzog ("Sur les oscillations à haute tension et de grande fréquence dans les réseaux à courant continu" in *L'Eclairage Electrique*, of November 17th, 1906) have discussed this question at some length.

A few of their figures (for a given length) are as follows :—

Section of conductor in sq. mm.	Volts per ampere of maximum current.
16	20
120	11·1
500	8·9
1,000	7·4

From the above it will be noticed that the rise of pressure may be very great, and the smaller cables (owing to their smaller capacity and greater self-induction) are more severely stressed than the larger ones.

It appears that engineers in charge of networks frequently find that their troubles occur not singly, but several almost simultaneously.

It therefore seems to me that if some data could be obtained showing that the faults were more frequent on the *smaller* cables, it would go some way towards indicating that these might have been punctured by the rise of pressure; the final breakdown perhaps being caused by local heating, etc. If any evidence were forthcoming to support this view, it would also suggest that the smaller cables should be more highly insulated than the larger ones.

W. H. F. Murdoch, B.Sc.

Halifax Technical College, *March 22nd*, 1907.

Electrolytic Lightning Arresters.

I was much interested in Dr. Garrard's letter in your last issue, and think the particulars he gives will be of great value in high-tension D.C. work. I should like, however, to correct one statement made near the end of the letter.

Dr. Garrard states there, that no H.T. D.C. work has been put down in this country since the date of his experiments in 1901.

This is hardly correct, as the installations at Newport (Isle of Wight), Twickenham and Weybridge have been erected since 1902, and extensions have been made to the systems in Guernsey, Bromley (Kent) and Folkestone, since that date.

The Twickenham system was briefly described in an article in the *Electrician* for September 16th, 1904, and the Newport and Weybridge plants are arranged on the same lines, being designed for the ultimate use of 5,000 volts D.C.

Dr. Garrard's experience with switching-off load on the Hull machines was probably typical of most shunt-wound D.C. machines of that period even with much lower voltages; but in recent years, as in the case of the machines for Twickenham and Weybridge, one of the tests specified was switching off full load at full voltage—say, 2,650; and though I remember that on one occasion the machine raced, so that the terminal voltage rose to something over 3,800 volts, there was no sparking at the brushes.

I believe it was also this machine which, owing to a mistake in the connections, was run up to full volts at the beginning of the test, and switched in on a short circuit; and neither brushes nor commutator were touched before going on with the six-hour test, at the end of which the full load was switched off.

In practical working there has been no tendency to flash over when the generator circuit-breakers come out, but only in the case of the H.T. breakers in the sub-stations coming out through shorts on the L.T. system, so that the generators are left connected to suddenly unloaded cables, when there is practically always a bad surge.

Ordinary disk arresters, as used on A.C. work, are not satisfactory, as an arrester designed for use on 5,000 volts A.C. will hold an arc on 500 volts D.C. when once it is started, and I would therefore venture to suggest that there is still a field for Dr. Garrard's device, if it can be supplied at a reasonable figure.

M. J. E. Tilney.

London, S.W., *March 23rd*, 1907.

The Unemployed.

Further to a letter in the REVIEW of 15th inst. by Mr. L. Douglas Leonard, I have a case which may interest him, but I regret to say one of English "courtesy"; however, I should be pleased to learn how the polling stands out of the remainder of the several he quotes, regarding national distinction.

On receipt of your valued paper here in Guernsey, I noted an advertisement for a wireman at 8d. per hour, the advertiser being a "gentleman" in Ramsgate; for this post I wired him and also sent a letter, but up to the time of writing have received no answer.

As I am at present out of employment through scarcity of work, it is indeed a puzzle with twentieth-century methods and manners to know what to do.

I trust that some of your "respected" advertisers may study a little more closely the feelings of their fellow men.

Lithgora.

"Concerning π."

On most 10-in. rules there is no line at 355, and if accuracy is desired it is better to multiply both quantities by 2, and to set 710 against 226. This refers to the bottom scale only; in Davis's rule π is marked on the top scale.

A. J. C.

Sheffield, *March 23rd*, 1907.

"Yorkshire" asks for information as to where he can obtain particulars of the "exposed" method of wiring in private houses adopted on the Continent; also where the material can be purchased?

ELECTRIC MOTOR VEHICLES AT OLYMPIA.

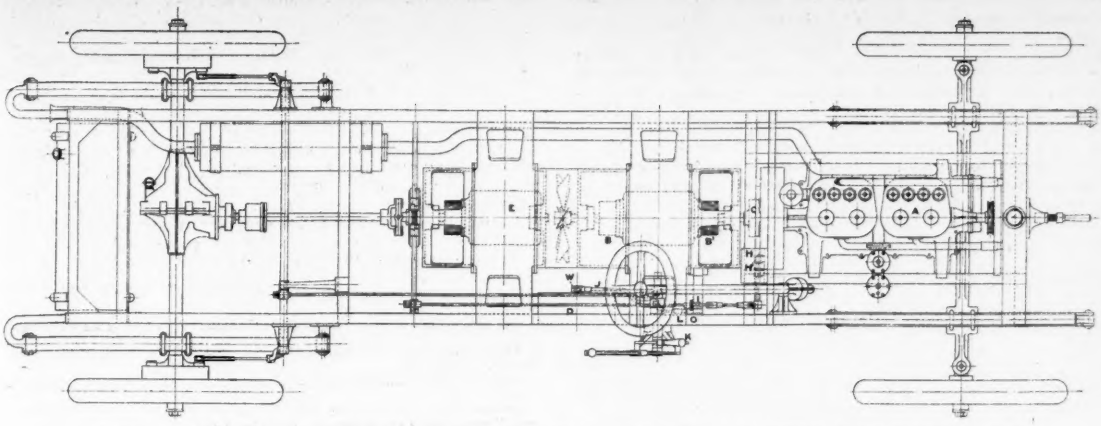
(*Concluded from page* 468.)

MESSRS. W. A. STEVENS, LTD., of Maidstone, showed their patent petrol-electric system, in which a dynamo driven by a 20-B.H.P. four-cylinder engine feeds a series-wound motor, which drives the road wheels by a cardan shaft and worm gearing.

The arrangement is shown in the accompanying plan, fig. 1, of the chassis; the dynamo is of the interpolar type made by Messrs. Stevens, with two commutators, and is capable of generating 15 KW. at 1,400 R.P.M., with fixed brushes and sparkless commutation. It is a "constant-watts" dynamo, giving 100 amperes at 90 volts, or 40 amperes at 200 volts, with the armature windings in parallel; and 50 amperes at 180 volts or 20 amperes at 400 volts, with the windings in series, the output varying only from 8 to 10·4 KW. A fan is fixed on the dynamo shaft, to cool both dynamo and motor. The leads from the dynamo pass through variable resistance switches to the controller and motor.

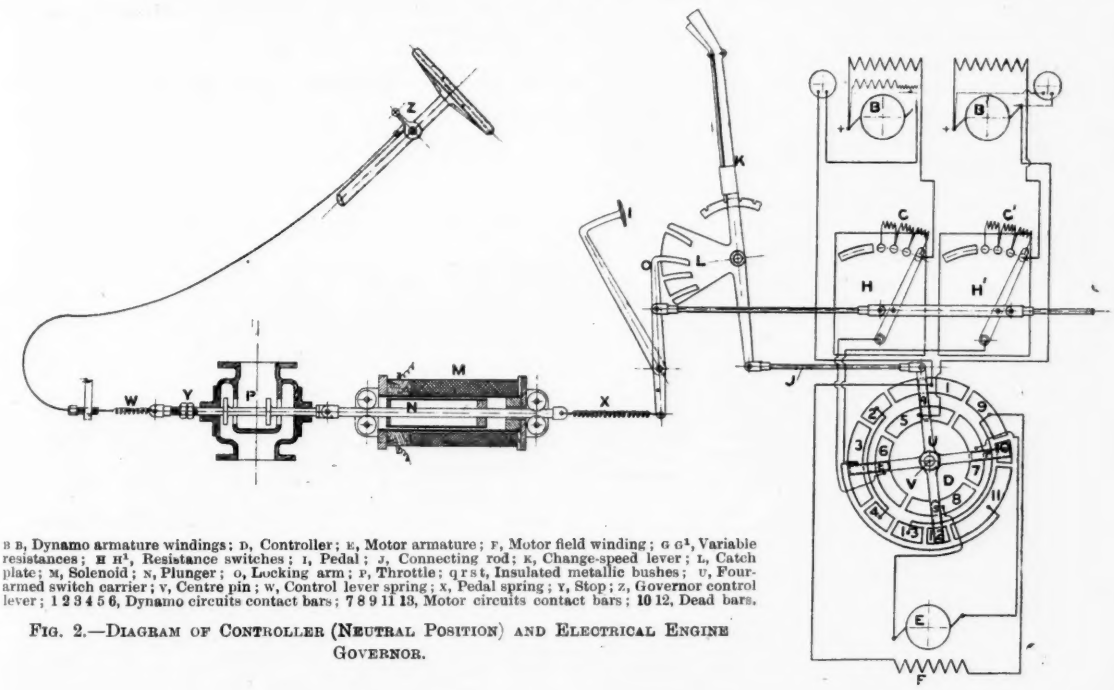
The controller embodies features peculiar to the Stevens system; it is shown, together with the electrical governor, in fig. 2. It will be seen that two forward speeds and one reverse are provided, and that the speed controller is interlocked with the governor and resistances. The controller takes the form of a flat circular switch, with contacts in two concentric circles and four insulated brushes carried by a spider. The resistances G and G_1 are controlled by the multiple-contact switches H and H_1, which are actuated by the pedal I; the controller is operated by the connecting-rod J from the change-speed lever K, which carries the catch plate L. It will be seen that the controller D cannot be moved until the pedal is depressed, all the resistance inserted between dynamo and motor, and the circuit broken, so that there is no sparking on the controller. The pedal in its extreme position puts on the brake. For low speed forward or reverse, the dynamo armature windings are in parallel; for high speed forward, they are in series.

The engine governor consists of a solenoid M excited in shunt from the dynamo, and tending to close the throttle P as the speed increases, in opposition to the spring W, which is connected with the governor control lever Z on the steering column. Thus the speed of the engine can either be varied by hand, or automatically controlled by the voltage of the dynamo. When the pedal is depressed, extra



A, Engine; B B^1, Dynamo; C, Flexible coupling; D, Controller; E, Series wound motor; H H^1, Multiple contact switches; I, Pedal; J, Change-speed lever connecting rod; K, Change-speed lever; L, Catch plate; O, Locking arm; W, Switch carrier lever handle.

Fig. 1.—Plan of Chassis.



B B, Dynamo armature windings; D, Controller; E, Motor armature; F, Motor field winding; G G^1, Variable resistances; H H^1, Resistance switches; I, Pedal; J, Connecting rod; K, Change-speed lever; L, Catch plate; M, Solenoid; N, Plunger; O, Locking arm; P, Throttle; q r s t, Insulated metallic bushes; U, Four-armed switch carrier; V, Centre pin; W, Control lever spring; X, Pedal spring; Y, Stop; Z, Governor control lever; 1 2 3 4 5 6, Dynamo circuits contact bars; 7 8 9 11 13, Motor circuits contact bars; 10 12, Dead bars.

Fig. 2.—Diagram of Controller (Neutral Position) and Electrical Engine Governor.

tension is put on the spring X, tending to close the throttle, so that the speed of the engine is reduced; an adjustable stop, Y, prevents the throttle from closing entirely.

The interlocking device prevents mistakes in controlling; the running of the car is almost noiseless, and the combined efficiency of the dynamo and motor is stated to be over 72 per cent. on full load. The system can be fitted to existing omnibuses without special construction of the frame, and we understand that a demonstration of its working is to take place shortly.

BUSINESS NOTES.

The Breaking of Trolley Wires.—Referring to our note on the breaking of trolley wires owing to the use of rigid suspensions, The British Thomson-Houston Co. remind us of the advantages of their flexible ear for grooved trolley wire, which overcomes the trouble complained of, and fulfils the requirements outlined in the paper written by Messrs. Tweedy and Dudgeon, as well as those specified in our note. We are informed that they have recently supplied a large number of these B.T.-H. flexible ears to the Dublin United Tramways, and the electrical engineer, Mr. P. S. Sheardown, writes saying he is very pleased with the smooth under-running obtained and the absence of any shock from the passing trolley wheel, though this is a very small wheel travelling at a very high speed, with which smooth running is particularly difficult; he considers it the best flexible ear in a practical form at present on the market.

Electric Clock Installations.—A correspondent writes that a system of electric impulse clocks has been in operation in his offices since the end of 1904, and he can fully endorse the remarks of Mr. Hope-Jones regarding the advantages of such a system being automatic. Before the installation of the electric system, it was a frequent occurrence to find one or more of the ordinary eight-day non-electric clocks stopped through neglect in winding. If the master clock of the present system required weekly attention, he fears he would be annoyed with a recurrence of the old trouble, with the additional disadvantage that all the dials would be stopped at once. The convenience and advantages of the automatic electric system are, in his opinion, beyond all question. This automatic impulse system goes, year in year out, with little or no attention, and only on very rare occasions has the pendulum required regulating. The system is also automatic in another manner, for timely notice of the impending failure of the battery is given by the ringing of a warning bell. This bell recently commenced to ring, but on the battery being attended to, it ceased. The master clock is labelled "The B.P. Patent," and its characteristic appears to be that the pendulum is driven by a gravity lever sliding down an inclined plane at each half-minute. The system is that of Messrs. Gent & Co., Ltd., Leicester.

Book Notices.—Messrs. Harper & Bros. are issuing another volume in their Electrical Series: "Electricity in Mining," by Sydney F. Walker, R.N., M.I.E.E., &c.

Messrs. W. Speaight & Sons, of 98, Fetter Lane, E.C., have issued a penny booklet giving a simple explanation of the Workmen's Compensation Act, 1906. The first section discusses the liability and general position of the employer, and the second those of the employé.

An Echo of the Helios Concern.—The Cologne Oberlands Gericht has confirmed the judgment of the Bonn Land Gericht in an action which recalls the misfortunes of the defunct Helios Electricity Co., of Cologne, whose manufacturing undertaking was jointly acquired two or three years ago by the Allgemeine Co., of Berlin, and the Siemens & Halske Co., or the Siemens-Schuckert Works Co., for the sole purpose of closing the works and preventing any fresh rival from constructing electrical machinery in this particular establishment. It appears that in 1900 the Helios Co. decided to make a fresh issue of shares and obligations, the former amounting to £100,000 and the latter to £300,000. A syndicate of banking firms was formed to take over the issues. One firm (A), one of whose principals was on the board of supervision of the Helios Co., participated in the transaction and offered to a second firm, which may be termed B, a subsidiary share as a sub-contractor. B made several payments to A, but refused to pay a balance of £591 on the unfortunate developments of the company, and contested the sub-contract on the alleged ground of "crafty deception," because A had not only not communicated any information regarding the situation of the company, but had represented the transaction as a thoroughly favourable one. A thereupon brought an action against B for the recovery of the money withheld, whilst B counterclaimed for the return of the money already paid. The Bonn court decided in favour of the plaintiff and dismissed the counterclaim, and this judgment has been confirmed by the higher court at Cologne.

Smoke Prevention. — We recently received from Direct Gas Fuel, Ltd., 17, Victoria Street, S.W., particulars of their Gregory patent smoke preventer, which consists of a cast-iron chamber fixed round the inside of the furnace-door opening of a boiler of any type, and provided with air inlets. The air is drawn by a steam jet into the chamber, where it is heated and mixed with the steam, and in this condition it passes over the fire. The result, it is said, is to secure complete combustion of the gases and prevent smoke, besides increasing the efficiency and economy of the furnace and enabling cheaper fuel to be used than would be possible without its aid. From such inquiries as we have been able to make of actual users, the apparatus gives satisfactory results, which are corroborated from other directions; and as the makers offer to fit the apparatus on approval free of charge, whether accepted or not, we can safely recommend inquiry into its capabilities.

Catalogues and Lists.—The Electrical Co., Ltd., Charing Cross Road, W.C.—Leaflet No. 229 giving a few particulars and note of prices of the "Economica" arc lamp.

Mr. T. W. Broadbent, Victoria Electrical Works, East Parade, Huddersfield.—Revised catalogue of the electrical machinery manufactured by him. This includes the standard D and B open types of generators and motors, M and C types of encased motors, also continuous current motor starters open and enclosed. The N and R types of single-phase motors are also described, these being of entirely new design just placed upon the market. We understand that they have given very satisfactory results.

Messrs. Alfred Herbert, Ltd., Coventry.—Section A, part 6 of their catalogue. It contains a full description of the firm's milling cutters and milling tools, followed by tables of prices and sizes, also illustrations of various cutters, arbors, collets, and chucks. A table of cutting speeds is given at the end of this 24 pp. pamphlet.

Messrs. Bagshawe & Co., Ltd., 3 Tower Royal, E.C.—Section S (12 pp.) price list containing illustrations, sizes and prices of their seamless steel buckets for chain or band elevators.

Messrs. Isenthal & Co, 85, Mortimer Street, W.—52-pp. pamphlet containing very full particulars, with illustrations and prices, of the high-tension condensers on the Moscicki principle, for which the firm holds the exclusive agency. The construction of the apparatus, the protection of line wires against atmospheric discharges, and the advantages of the Moscicki system, the method of mounting, the use of condensers in wireless telegraphy and X-ray work, a method of suppressing the lag and the phenomena of resonance in alternating currents, together with a description of its application to tramway motors; a method of starting asynchronous single-phase motors—these are some of the sections in this publication which, we have no doubt, will interest many of our readers. The condensers can be seen at the firm's address as above.

Messrs. Johnson & Phillips, Ltd., Charlton.—Small 8-page illustrated booklet dealing with their single and three-phase transformers of air and oil-cooled types. Among the illustrations is a view of a corner of the transformer shop at the works.

Trade Announcements.—Messrs. Pritchetts and Gold, Ltd., of Feltham, Middlesex, have purchased the goodwill, plant and stock of the A.B.P. Accumulator Co., Ltd. (in liquidation), and are prepared to execute orders for renewals for A.B.P. batteries.

The New Brotherton Tube Co., Ltd., have appointed Messrs. Andrews & Co. (late Messrs. Andrews, Davidson & Co., of 126, Bothwell Street, Glasgow) sole agents for the supply of their electrical conduits in Scotland. Messrs. Andrews will shortly be moving to the company's present premises, 198A, St. Vincent Street, and all letters should be sent to that address. The New Brotherton Tube Co. keep a large stock in Glasgow.

Messrs. J. Butler & Co, machine tool makers, Victoria Iron Works, Halifax, have appointed as their sole London representatives Messrs. J. E. Lawler & Muirhead, 39, Lime Street, E.C.

Messrs. Ernest Scott & Mountain, Ltd., of Newcastle-on-Tyne, inform us that they are just about to open a new suite of offices in the corner building at the junction of Queen Victoria Street and Cannon Street, London. This office overlooks the Mansion House Station, the entrance being 49, Queen Victoria Street, E.C. Messrs. Scott & Mountain's London business is under the care of Mr. R. Hood Haggie, who has been with the firm for a number of years, and is well known in mining circles. Mr. Haggie is assisted by Mr. A. E. Backhouse, who has been trained with the firm, and is now responsible for a great part of the London business. Any inquiries and correspondence addressed to their London office will receive equal attention to that sent to Newcastle, and for firms situated in the south of England, a saving of time can often be effected by writing to the London office. The firm's telephone number and telegraphic address will remain unaltered, viz.: 8,349 Bank and "Escamotur, London," respectively.

Messrs. Potter, Thomas & Co., 1, St. Nicholas Buildings, Newcastle-on-Tyne, have been appointed sole representatives for the North-East Coast for—

James Howden & Co., Glasgow, for their high-speed engines, turbines, and other manufactures.

Templer & Ranoe, Ltd., Sterling Works, Coventry, for high and low pressure valves, separators, &c.

Bray, Markham & Reiss, Ltd., Walthamstow, for their starters and all classes of switchgear.

Norman K. Peace, Pioneer Steel Works, Sheffield, for tool steel "hurricane" and "auto" high-speed steel for lathe tools, &c.

Electrical Installations, Ltd., of 11, Queen Victoria Street, E.C., have just removed to more commodious offices and stores, and their new address is Bassishaw House, Basinghall Street, E.C. Their telephone number remains the same. The branch at 2, Mincing Lane, E.C., has been closed, and all business will be dealt with from Bassishaw House.

LIGHTING and POWER NOTES.

Aberdeen.—A report has been submitted intimating that terms have been concluded for the purchase by the T.C. of the undertaking of the Deeside and District Electric Light Co., Ltd., Cults.

Acton.—The L.G.B. has sanctioned the borrowing by the U.D.C. of sums amounting to £18,987 in respect of the electricity undertaking, made up as follows:—£4,487 in respect of excess expenditure and cost of new works; £13,000 to meet prospective expenditure on mains and house services; and £1,500 to meet prospective expenditure on meters. The amount applied for was £20,000. The Board deducted certain items which were not properly chargeable to capital, representing a total of £1,013.

Blackheath.—At a meeting of the Blackheath Traders' Association last week, the Secretary stated that he had asked the South Metropolitan Electric Light and Power Co. if it intended to compensate the tradesmen for loss in respect to failure of the electricity supply during Christmas week. It will be remembered that a disastrous explosion occurred at the company's generating station at that time. The company replied that it would favourably consider any claims sent in. Several claims had been sent in, but the company had denied all liability. The secretary of the supply company attended the meeting, and denied that his company was in any way liable for the results of the unfortunate accident. The accident was unforeseen and unavoidable, as far as the company was concerned. With regard to users of electric power, who were under an agreement to take a certain specified consumption, and had been prevented from so doing by the accident, the company would make allowance for this deficit in the consumption.

It was stated that the company contemplated reducing the price per unit for supply.

Coventry.—The Meriden U.D.C. has assented to an application made by the Corporation for an extension of the area, to enable a supply of electrical energy to be given to the parishes of Allesley and Coundon. The Foleshill R.D.C. has also consented to a similar application.

Croydon.—The Croydon Gas Co. has repeated an offer which it made two years ago to the Corporation, to light a section of the town with gas free of charge for six months, in order to demonstrate that the town can save the equivalent of a penny rate by dispensing with the electric arc lighting.

Continental Notes.—Turkey.—The ancient city of Damascus, the capital of Syria, is claimed to be the first in Turkey to be provided with an electric lighting station and tramways, the formal inauguration of the combined undertaking having taken place on February 7th. The concession for this purpose was obtained by the Société Anonyme Impériale Ottomane de Tramways et d'Eclairage Electrique, which was constituted by the well-known Société Générale de Chemins de Fer Economique of Brussels. According to a correspondent at Damascus, the power station is situated at El Tequieh, about 25 miles distant from the city, and the river Barada, which also flows through Damascus and supplies it with potable water, is drawn upon for the driving of turbines giving 1,000 effective h.p. The energy generated is stepped up to high pressure and transmitted to the substation at Damascus by means of overhead conductors. Here the pressure is

reduced by transformers, and converted into D.C. at 550 volts by means of three motor-generators. This is the pressure used for the tramways, and is apparently that employed for the outer wires of a three-wire system of distribution for lighting purposes. The public lighting of the city is effected by 1,000 arc and incandescent lamps. The electric tramway, which connects the two suburbs of Salatriyé and Meidan with the city, has a total length of 3·3 miles, and extensions to other parts of the city area are in contemplation. The inaugural ceremony was attended not only by the military and municipal authorities, but also by the Government Commission from Constantinople, which inspected the works on behalf of the State, and which may be concerned in the settlement of electric lighting and tramway questions in the capital of the empire.

The Turkish Ministry of Public Works has approved plans for the establishment of an electric power station at Salonika for electric lighting and traction in the town.—*Board of Trade Journal.*

SWEDEN.—The *Board of Trade Journal* says H.M. Consul at Stockholm reports that the waterfall of Dingersjo has been bought by the Holmia Electrical Company, of Stockholm. The power-station will be equipped with three turbine generators each of 800 H.P.

Dudley.—On the 19th inst. Mr. H. R. Hooper held a L.G.B. inquiry in an application by the T.C. to borrow the sum of £3,000 for mains extensions.

Edinburgh.—The T.C. has agreed, on the recommendation of the E.L. Committee, that application be made to the Secretary for Scotland for consent to borrow £85,000 for capital works, for the two years to May 15th, 1908.

Friern Barnet.—The B. of T. has revoked the 1901 Electric Lighting Order.

Gillingham (Kent).—The T.C. has applied to the L.G.B. for a loan of £5,000 for private lighting extensions.

Hanwell.—The U.D.C. is completing arrangements whereby electrical energy will be supplied by the Metropoltian Electric Supply Co.

Hanley.—A report presented last week by the chairman of the E.L. Committee, showed that the total output of electricity from the Corporation works during the past year was 1,102,194 units an increase upon the previous year of 192,597 units. During this period of two years the output of electricity for power purposes had trebled.

Hull.—A special meeting of the City Council was held on the 21st inst. to receive a recommendation from the E.L. Committee that a tender for a new steam dynamo be accepted at once. The Committee had been requested to advertise for tenders, but it again came forward with the excuse that there was not time enough to do this, if the plant was to be installed in time for next winter's load. A councillor, in moving that the minutes be again sent back, remarked that the Committee was evidently intent upon getting Lahmeyer plant. He desired the fullest possible inquiry made as to whether the Council could not get as good a machine from a British firm. Another member supporting this contention, said the Corporation must advertise. The amendment to refer the minute back was defeated by the casting vote of the Mayor. Another amendment was then moved that the Committee should carry out the instruction of the Council and advertise for tenders. On a division this was lost by 23 votes to 17, and the minutes were carried. Immediately after this Council meeting, the E.L. Committee met, and resolved to accept the tender of the Lahmeyer Co. for a generator at £3,915, subject to the confirmation of the Council.

India.—The *India Daily News* says plant for the electric light installation at the Chitpore Station of the Eastern Bengal State Railway has been purchased locally, and that the cost of the installation is about 28,000 Rs.

Isleworth.—The Council has received a report from its Finance Committee on the question of liquidating the outstanding debt on the electric lighting revenue account, which on December 31st last, totalled £1,901 in respect of installations on free-wired premises. As a result, application is to be made to the L.G.B. for sanction to a loan of £1,900 to cover the amount outstanding.

Japan.—The *Anglo-Japanese Gazette* says there are in Japan upwards of 100 water-power installations, and some very important schemes are now under construction. Among the latter may be included a power station for Kyoto with a canal 7 miles in length. The capacity of this station will be 4,400 H.P. The power scheme for Tokyo, on the Tamagawa River, will have a 20,000-KW. transmission line at 40,000 volts, over a distance of about 25 miles. Another large station of about 32,000 KW. is to be erected between Kyota and Osaka. Japanese enterprise has also taken over water-power installations in Korea.

Lowestoft.—The T.C. has decided to apply to the L.G.B. for a loan of £17,950 for electricity purposes.

Watford.—The L.G.B. inquiry into the application of the U.D.C. for a loan of £13,500 for electricity purposes, was resumed on March 19th, when it was stated that the Council would withdraw the sum of £4,551 for a coal conveyor. The Inspector, Mr. H. R. Hooper, asked why the Council supplied energy to certain works at 1d. per unit, whereas, with a much better load factor, 3½d. per unit was charged for public lighting. He also drew comparisons between the price of gas and electricity for public lighting. It was intimated that these questions would be further considered by the Council, and the inquiry was again adjourned.

Wath.—The T.C. held a special meeting last week to consider the E.L. question. The promoters of the Barnsley, Wombwell, and Wath Tramways Bill, by failing to comply with the Standing Orders, and allowing the Bill to drop, have placed the Council in a quandary, as the former had committed themselves to an arrangement whereby the Council should be supplied with electric tramways and electric light. In order that the prov. order obtained by Council for electric lighting should not be allowed to lapse, the surveyor, at the request of the Council, has prepared a scheme for the public lighting of the town by electricity. The report calculated that the capital outlay would be £6,250. It was finally decided to apply to the B. of T. for a renewal of the prov. order, which expires on May 11th, and to point out that the Council was at present engaged in seeking expert opinion on the surveyor's scheme.

West Bromwich.—The Electricity Committee of the Corporation has recommended that £800 be granted from the profits of the electrical undertaking in relief of the general district rate.

Woking.—The B. of G. on March 20th appointed a committee to consider the advisability of having the Workhouse lighted by electricity.

TRAMWAY and RAILWAY NOTES.

Australia.—TOWNSVILLE, Queensland.—Permission was given some time ago for an electric tramway system to be constructed within the municipality. A gentleman has visited London in connection with the scheme, which is estimated to cost £120,000.

KEW AND ST. KILDA, Victoria.—Messrs. Noyes Bros. have reported upon the scheme for constructing an electric tramway between these two suburbs of the metropolis. They state that by laying the line on sleepers the cost would be £72,670; with concrete, £56,280—exclusive of any alterations to other works. The former method is recommended.

A proposal has been put forward to ask the Government to construct an electric railway from Elsternwick to join the Brighton to St. Kilda electric tramway at Elwood.

Birmingham.—The Tramways Committee has decided to effect an improvement in the regulation of the tram services by the introduction of a system which will put a stop to the excessive speed at which it is alleged the cars are sometimes run in certain suburbs. A self-registering time recorder, or indicator clock, is to be placed within a few hundred yards of each suburban terminus, and it will be the duty of the conductor of every car to record on the clock the time his car passes on the outward and inward journeys. The record will be made automatically at the moment the conductor inserts his key, and the number of the key will also be indicated. By these means the time of every car can be easily checked.

Continental Notes.—BRUSSELS.—It is stated in the report for 1906 of the Brussels Tramways Co., that the receipts from the working of the lines were very unfavourable during the last days of December owing to the snowstorm. The salt used to melt the snow caused damage to the rolling stock, and at times stopped the service, the underground conduit lines being specially affected in this way. The total income in 1906 amounted to 11,622,131 fr., and the working expenses to 5,804,255 fr. After meeting interest charges, and providing for depreciation of rolling stock and machinery and permanent way, the accounts show a balance of 3,943,048 fr., of which the sum of 3,884,000 fr. is proposed to be distributed among the two classes of shareholders. In 1899 the total length of the tramways was 23·5 miles, and the extensions already made, and those authorised, make a total length of 55·8 miles. During the year, the company made reductions in the fares, extended the use of transfer tickets, introduced workmen's fares on certain lines, and lowered the prices of season tickets for scholars of from 16 to 20 years of age. In addition to this, improvements have been made in the conditions of the employés by reducing the length of the working day and raising the wages. The power station has been equipped with a fifth generating set of 1,500 KW., and the total output amounted to 17,029,600 KW.-hour, as compared with 14,556,900 KW.-hours in 1905.

RUSSIA.—Surveys for an electric railway from Tiflis to Vladikavkas and Beslanovsk have been commenced. The cost of the scheme is estimated at 15,000,000 roubles.

Luton.—The T. C. has accepted the offer of Messrs. J. G. White & Co. to construct and work electric tramways in the borough. The contract price is fixed at £60,500, and the company is to pay all interest and sinking fund charges on the loan, and 20 per cent. of the net profit earned to the Corporation. Power is to be taken from the Council at 1½d. per unit up to 120,000 per annum, 1¼d. per unit for 120,000 units to 300,000, and 1d. per unit beyond, with a minimum payment of £750 a year.

Manchester.—On the 25th inst. the Corporation commenced a service of cars from Chester Road along Ashfield Road to Sale Railway Station. It is hoped that cars will be run to Altrincham some time before Whitsun week.

Middlesex.—The daily Press report that as a result of a conference between the representatives of the Acton U.D.C. and the Middlesex C.C., the construction of electric tramways from Willesden to Acton will be commenced immediately.

Plymouth.—The Corporation has decided to borrow £2,000 in respect of the construction of tramways at Prince Rock.

Rangoon.—From *Indian Engineering* we learn that the electric tramways have now been opened from the Strand Road to the Shwe Dagon Pagoda.

Wednesbury.—Cars have commenced running to and from Wednesbury and the Pleck, a section which has been reconstructed. The Pleck to Walsall section is still in the hands of the contractors.

TELEGRAPH and TELEPHONE NOTES.

Telephones.—Mr. Carr Gomm, in the Parliamentary papers, asks the Postmaster-General whether he is aware of the inconvenience caused to numbers of persons who, having signed the form of application for a private telephone apparatus, have had to wait a considerable time, in some cases as much as six weeks, before being able to use the telephone; whether he has considered the necessity of largely augmenting the staff of this department, in view of the increasing number of subscribers' applications to be complied with; and, if so, what steps he proposes to take. Mr. Buxton, in reply, says:—"So long a period as six weeks would not be occupied in the completion of a Post Office telephone exchange line, unless there were some exceptional difficulty in construction or in obtaining wayleaves from local authorities. The completion of a line provided recently for the honourable Member was unfortunately delayed owing to the necessity for laying a new main cable on a section of the route between his house and the exchange, and some further delay occurred owing to the Christmas holidays. The circumstances were, however, exceptional. The Post Office engineering staff is receiving large additions to provide for the increasing telephone work."

Transmission of Writing and Portraits.—A demonstration has just been given at Brussels by M. Camille Fontaine of an invention devised by M. Henry Carbonelle, a Belgian engineer, for the transmission of written communications, drawings, portraits, etc. It is stated that the apparatus used resembles an Edison phonograph, and that messages to be transmitted are written on metallic paper, as for instance tinfoil, with an ink mixture composed of "indiarubber and Indian ink." The paper thus written on is then placed on the cylinder of the apparatus. An electric current is passed through the membrane and the membrane style to the metallic paper and thence to the receiving station. The latter is equipped with a similar phonograph-like apparatus and is in electrical connection with the transmitting station. The characters written on the metallic paper represent continued interruptions in the current, and these are reproduced by the style of the membrane of the receiving station. At the demonstration, in addition to the transmission of writing, a large portrait of the king of Belgium was transmitted in 1 minute 4 seconds. The Belgian post-office authorities, it is declared, have transmitted a similar portrait on the Antwerp-Brussels telegraph line with the Carbonelle system in 1 minute 20 seconds, a speed twenty times greater than with the Korn system. It is claimed that the Carbonelle method allows of the transmission of from 300,000 to 500,000 letters in an hour, and the inventor considers that anyone sending a telegram at a telegraph office would be able to do so by means of his apparatus in a minimum of time. M. Carbonelle, who has been working at the invention since 1889, has been supported in his ideas by M. Anspach-Puissant, professor at the university of Brussels.

CONTRACTS OPEN and CLOSED.

OPEN.

Belgium.—March 30th. The municipal authorities of Liége invite tenders for a central station. For further particulars see our issue of January 25th.

Bremen.—April 4th. The Prussian Government Railways require tenders by April 4th for an electric travelling crane. Particulars may be obtained on payment of 1s. to the Eisenbahnbau inspection, 3, Werderstrasse, Bremen.

Bristol.—April 9th. Supplies (carbons, motors and starters, joint and junction boxes) for the Electricity Department. See "Official Notices" March 22nd.

Copenhagen.—April 11th. Three motor-generators or converters, each of 1,000 KW., for the Corporation. See "Official Notices" March 1st.

Edinburgh.—April 8th. Materials for the Corporation electricity supply department. See "Official Notices" March 22nd.

Glasgow.—April 8th. Stores for the tramways department. Samples, &c., at the Purchasing Department, 46, Bath Street.

Handsworth.—April 24th. Extension pipe-work for the U.D.C. electricity works. See "Official Notices" to-day.

Holland.—April 4th. The provincial authorities at Haarlem are inviting tenders for an installation of electric lighting along the North Sea canal.

Holland.—April 6th. The municipality of Utrecht require tenders for one turbo-dynamo of 500-600 KW. by April 6th. Specifications, &c, may be obtained from the Secretaire Communal, on payment of 4s.

Iceland.—March 31st. The Reykjavik Town Council is open to give a concession for the supply of electrical energy and gas. See "Official Notices" December 7th.

Islington.—April 4th. Meters for the B.C. See "Official Notices" March 22nd.

Italy.—April 15th. Tenders for the Royal Arsenal (Contract Offices) of Spezia, for supply to the Italian Navy of two three-phase 100-KW. converters. For further particulars see our issue of March 22nd.

Lancashire & Yorkshire Railway.—April 1st. Stores for one year, including signal and telegraph fittings, also electric light and other wires. Particulars from Mr. Waring, stores department, Osborne Street, Manchester.

Newcastle-upon-Tyne.—April 2nd. Construction and erection of electric cranes on the Quay, for the Corporation. See "Official Notices" March 8th.

Prestwich.—April 4th. Electrical equipment comprising (*a*) generating plant and motors; (*b*) lifts and hoists; (*c*) bells and telephones, for the new infirmary at Blackley. See "Official Notices" March 8th.

Roumania.—March 29th and 31st. The Director of Posts, Telegraphs and Telephones, at Bukarest, requires tenders as follows:—

March 29th.—2,000 Leclanché cells.
March 31st.—Annual (sundry) supplies.

Spain.—March 31st. The Harbour Works authorities at Huelva are inviting tenders for the establishment of a central station for the supply of the necessary electrical energy required for lighting and power purposes at the harbour.

Spain.—May 26th. The Public Works Department will receive applications for two concessions as follows:—(1) Construction of electric tramways in Barcelona; extension of line from Josepets to Bonanova. (2) Construction of electric tramway from Marsala to Marbella.

Sunderland.—April 11th. Stores for the tramway department. See "Official Notices" March 22nd.

Turkey.—The Post and Telegraphs (Administration Générale) require tenders for bronze telegraph wire of 2 mm. diameter, 720 insulators, and three Siemens lightning conductors.

Wallasey.—April 15th. Stores for the electricity department. See "Official Notices" March 22nd.

Witney.—April 2nd. Gas engine and dynamo, and suction gas plant for the Witney Electric Supply Co. See "Official Notices" March 15th.

CLOSED.

Bolton.—The Corporation have just placed a fourth repeat order with Triumph Stoker, Ltd., to equip three more boilers with "Triumph" stokers.

Bury (Lancs.).—The T.C. has accepted the tender of Galloways, Ltd., for the supply of a boiler, and that of Messrs. Bolton & Co., of Manchester, for a superheater.

Grimsby.—The E.L. Committee has accepted these tenders:—

Pump motor and switchgear.—Brush Electrical Engineering Co., £166.
Feed pump.—J. P. Hall & Sons, £102.
Arc lamp carbons.—Sloan Electrical Co.
Voltage regulator.—B.T.-H. Co., £280.

Hull.—The E.L. Committee of the T.C. on March 21st decided to inform the Lahmeyer Electrical Co. that, subject to the confirmation of the Council, their tender had been accepted for the supply of a steam dynamo, at £3,915. The Committee had twice previously recommended the acceptance of the tender, but the Council had declined to adopt the recommendation.

London.—Stepney.—The Electricity Committee recommends that, in order to make provision for next winter's anticipated load, the tender of Messrs. Babcock & Wilcox for two boilers, at £4,240, be accepted; further, that two additional stokers be obtained from the Underfeed Stoker Co., Ltd., for £433.

Battersea.—The following tenders for annual supplies to the generating station have been provisionally accepted by the Electricity Committee:—

W. H. Willcox & Co.—Oils and engine-room stores.
Sloan Electrical Co.—Carbons.
Ferranti, Ltd.—Ampere-hour meters.
B.T.-H. Co.—Watt-hour meters.
Callender's Cable & Construction Co.—Service boxes, with the exception of house service boxes of a capacity of 25 and 100 amperes; also supply of cables, provided the company undertake to maintain the whole of the cables supplied by them for a further period of one year.
B.T.-H. Co., and Edison & Swan United Electric Light Co.—Incandescent electric lamps.
Pryke & Palmer.—Ironmongery, tools, &c.

Fulham.—The E.L. Committee has accepted the following tenders for annual supplies:—

Packings, jointings, &c.—Messrs. H. Edmonds & Co.
Street-lighting. &c., goods.—Messrs. J. Gibb & Co.
Fuse wire, &c.—General Electric Co., Ltd.
House cut-outs, service boxes, &c.—Messrs. Lucy & Co.
Engine oils.—Messrs. W. H. Willcox & Co., Ltd.

Mansfield.—The T.C. has accepted the tender of the Mansfield Engineering Co. for a telephonic installation to the Clipstone pumping station at £314.

Plymouth.—The T.C. has accepted tenders for annual supplies as follows:—

Cables.—British Insulated & Helsby Cables, Ltd.
Carbons.—Sloan Electrical Co.
Oils.—Blumann & Stern; Duckham & Co.; Hawken & Co.; H. Lawry, Ltd.; Stern Sonneborn.
Street box and sub-station transformers.—British Electric Transformer Co.
Trolley wire.—British Insulated & Helsby Cables, Ltd.
Fittings, trolley line materials, &c.—Dick, Kerr & Co.

A sum of £500 for Thermit welding on the Prince Rock section is included in the tramway estimates for the year.

Rugby.—The U.D.C. has accepted the tender of W. T. Henley's Telegraph Works Co. for the supply of cable, at £121.

Southend.—The T.C. has accepted the following tenders:

Ferranti, Ltd.—Meters, £144 6s.; also a running contract for meters at the following prices:—Three amperes, £1 16s.; five amperes, £2; 10 amperes, £2 5s.; 18 to 25 amperes, £2 10s.; 50 amperes, £2 17s. 6d.

Walthamstow.—The U.D. Council has accepted the following tenders for boilers, generating and condensing plant, &c.:—

Babcock & Wilcox.. ..	£11,375	Alphons Custodis Co. ..	£856
Electric Construction Co.	7,134	Johnson & Phillips	830
Ledward & Beckett ..	3,437	Patterson Engineering Co.	425

CONTRACTORS' COLUMN.

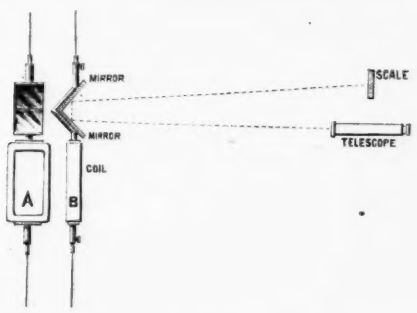
Openings for New Business.

ACTON, W.—Four houses (electric light intended) in Derwentwater Road. F. Kerven, builder, Acton.
BARNSLEY.—New theatre. North & Robins, architects, 203, Strand, London.
CAMBRIDGE.—New County School.
CARDIFF.—Out-patient's department at the infirmary. E. Seward, architect, Queen's Chambers, Cardiff.
Enlargement of St. Dyfrig's church (£3,689). John Allan & Co., builders, Cardiff.
CHISWICK.—Four high-class villa residences in Duke's Avenue. Prentice and Co., builders, Pimlico.
COCKTON HILL (Durham).—New council school. County Education Committee's architect, Shire Hall, Durham.
GLOUCESTER.—Public schools. W. B. Wood, architect, 12, Queen Street, Gloucester.
HALIFAX (Norwood Green).—Mission church. Howorth & Howorth, architects, Old Bank Chambers, Cleckheaton.
Additions to Clark Bridge Mills. W. Clement Williams, architect, 29, Southgate, Halifax.
LEICESTER.—Nursing home to be built at the Infirmary (£20,000).
LONDON (Deptford).—Factory on site of 83-167, Childers Street. Stock, Page and Stock, architects, 9, Denman Street, London Bridge, S.E.
(Kensington).—Rebuilding and extension of Post Office, Archer Street (£5,000). H.M. Commissioner of Works, Storey's Gate, S.W.
(Bow, E.).—Additions to factory of the Britannia Folding Box Co., 52, Dace Road, Bow, E.
(St. Pancras).—Municipal dwellings for working men. Joseph and Smithem, architects, 82, Queen Street, Cheapside, E.C.
(Southwark).—Building on site of 45-47, Union Street, and 34, Red Cross Street. E. Runtz & Ford, architects, 10, Walbrook, E.C.
(Stratford, E.).—Additions to factory for Messrs. Ling, Van der Wall & Co. M. Hudson, architect, 87, Finsbury Pavement, E.C.
(Southwark).—Factory for Maltina Co., W. Egerton, architect, 12, Queen's Road, Erith.
(Brixton).—Flats in Lyham Road. H. J. Capell, architect, 20, Lynette Avenue, Clapham, S.W.
(Rotherhithe).—Building in Ilderton Road. J. T. Bressey & Son, architects, 70, Bishopsgate Street Within, E.C.
(Rotherhithe).—Additions to Amicable Society's School. R. Page, architect, 9, Denman Street, London Bridge, S.E.
(Islington).—Meter Factory. G. H. Lovegrove, architect, 170, High Street, Shoreditch.
(Putney).—Sunday school in Gwendolen Avenue.
(Battersea).—Factory and offices. E. Lawrence and Sons, builders, 14, Wharf Road, E.C.
(Battersea).—Re-building catholic schools in Trott Street.
(Kingsway).—Re-building church.
(Holloway).—Fire station. W. E. Riley, superintendent architect, L.C.C.
MIDDLESBROUGH.—Hippodrome. G. F. Ward, architect, Birmingham.
NEWCASTLE-ON-TYNE.—Extensions to Westmorland Road public schools. City Property surveyor.
OLDHAM.—Council School. T. Hilton, architect, 7, Union Street, Oldham.
POCKLINGTON.—Public schools. Building surveyor, County Hall, Beverley.
ROCHDALE.—Infirmary is to be extended.
SCARBOROUGH.—Enlargement of Scarborough railway station. Blackett and Sons, contractors, Darlington.
STOCKPORT.—Public schools in Newbridge Lane. Cheers & Smith, architects, Blackburn and London.
STOKE-ON-TRENT.—A new Post Office is to be built.
SURBITON.—Additions to Tolworth hospital (£6,000). W. H. Woodroffe, architect, 32, High Street, Borough, S.E.
THORNE (Doncaster).—Public school (£2,131). W. H. Smith, builder, Thorne.
TORQUAY.—Secondary school to be built (£25,000).
TON (Rhondda).—New Bethesda chapel (£5,500). W. D. Morgan, architect, Pentre; contractors, Hughes & Stirling, Bootle.
WILLESDEN, N.W.—Disinfecting station. A. W. J. Russell, town clerk, Paddington.

NOTES.

Robertson Electric Lamps, Ltd., v. Robstone Lamp and Illuminating Co., Ltd.—This case again came before Mr. Justice Swinfen Eady on Friday, March 22nd. When it came before his Lordship previously, it was for an injunction, which he refused, his Lordship expressing the opinion that an early trial would be preferable, and he gave directions for the prompt delivery of pleadings. On Friday it was mentioned that defendants had offered to submit to a perpetual injunction restraining them, their servants, &c., from selling, or offering, or exposing, or advertising for sale or procuring to be sold any electric lamps or any apparatus or things used in connection with electric lamps not being of the plaintiffs' manufacture under the name of "Robstone," or any name comprising that word, or any other name so closely resembling Robertson as to be likely to mislead or deceive the public into the belief that the goods manufactured or sold by the defendants were the goods manufactured or sold by the plaintiffs.—His Lordship assented to these terms.

Galvanometer Mirror.—Although it is possible to suspend a galvanometer mirror in such a way as to suppress the effects of horizontal vibrations—for instance, by accurately balancing the system about the axis of suspension, the latter being of the marine type, and by electro-magnetic damping—it is much more difficult to get rid of the oscillations about a horizontal axis, which may render telescope reading impossible. A neat device is described by Mr. E. F. Northrup in the *Physical Review* of February last, by means of which the vertical movement of the image is entirely suppressed. This is shown in the figure below, where A is the



front elevation of the moving coil of a galvanometer, and B is a side elevation of the same. It will be seen that the coil is fitted with two mirrors at an angle of 90° with one another. Rotation of this system about a horizontal axis has no effect on the view of the scale through the telescope, and further, if the scale and telescope are vertically raised or lowered together in an arc of which the mirror is the centre, the image of the scale remains visible in the telescope without separate adjustment, making it very easy to find the scale. The double mirror system otherwise behaves exactly like a single plane mirror, and by placing a suitable lens in front of it, a spot of light can be cast upon a scale if desired.

Institution Notes and Lectures.—Sheffield Society of Engineers and Metallurgists.—On 18th inst. Mr. A. Piggott, of Manchester, lectured before this Society on "Water-Tube Boilers; their Value for the Utilisation of Waste Heat Generally." Prof. Ripper presided.

Institution of Engineers and Shipbuilders in Scotland.—On Tuesday last week a paper was read by Mr. Wilfrid L. Spence on "The Mechanism of Power Transmission from Electric Motors."

The Institution of Electrical Engineers.—As announced by the President at the ordinary general meeting on 21st inst., the Council has elected Prof. J. J. Thomson, D.Sc., Cavendish Professor of Experimental Physics at Cambridge and Professor of Physics at the Royal Institution, an honorary member of the Institution of Electrical Engineers.

A Medical Electrician's Will.—A correspondent writes: "Dr. James Gale, M.A., Ph.D., F.S.S., F.C.S., of 124, Adelaide Road, South Hampstead, N.W., formerly of Plymouth, the blind medical electrician, who died on February 12th last, aged 73 years, left estate of the gross value of £11,333 15s. 9d., of which the net personalty has been sworn at £10,691 9s. 3d. The deceased was reported to have taken a sum of £50,000—the largest fee ever known to have been paid for medical electrical attendance. Dr. Gale had appeared before their Majesties the King and Queen and the late Queen."

Reyrolle Debating Club.—The third meeting of this club was held on Friday, March 15th, when Mr. Fullagar read a paper on "Thermo-dynamics," dealing chiefly with the limitations to possible efficiency which follow theoretically from the consideration of Carnot's cycle and the limits of temperature obtainable in practice. On Thursday, March 21st, Mr. Coates resumed the discussion on "Current Transformers," dealing with their mechanical construction, and by the aid of diagrams he explained the principal considerations in the electrical design. Mr. Reyrolle occupied the chair.

Assessment of Warehouse Property.—The secretary of the Machinery Users' Association writes as follows:—"May I call your attention to a decision of far-reaching importance to occupiers of rateable property, which has recently been given in the case Rex *v.* Melladew, by the Court of Appeal.

"The point at issue was to determine the question of liability for the payment of the local rates in respect of a building situated at Liverpool, and used for the purposes of a warehouse, it having been contended that there was no liability attaching thereto for the payment of the rates, inasmuch as all the tenant's fixtures and utensils having been removed, and the building put into the market to be let, it was like an empty house and its owner was not liable to be rated. The Court of Appeal have, however, decided that having regard to the character of the user of property of this class, and to the fact that the owners occupied other warehouses, and that in this particular case it was possible for the owners at any time to resume its occupation, the local authority were justified in demanding the payment of the rates. As you will see, this decision is of far-reaching effect, and likely to be very prejudicial to occupiers of all classes of property who are subject to fluctuations in trade. In the opinion of my Committee, this judgment is contrary to the intentions of Parliament and to previous decisions of the High Courts upon questions of this character, and it is proposed to call a meeting of those of the members of this Association who are affected by the judgment, with a view to endeavouring to arrange to carry the appeal to the House of Lords. The question is particularly important in the case of associations or companies controlling a number of works, as I am aware that it is sometimes found to be necessary to keep one or more, and sometimes parts of works idle for considerable periods, owing to the course of trade, or to some cause connected with the property itself. The decision I have referred to was given in connection with warehouses, but will apply with equal force to any other classes of property which are subject to the same circumstances as were stated in the case submitted for decision. It appears to me that the judgment of the Court of Appeal would also be held to cover the case of works which were idle owing to bad trade or other causes, but were not put into the market to be let. It has, therefore, occurred to me that the interest of many of your readers in the question is sufficiently important to warrant my making the suggestion that they should support the action of this Association by identifying themselves with the proposed combination. I shall be happy to give further information upon the subject to any of your readers who may desire it.

"J. B. Caldwell, *Secretary*."

Canadian Power Supply. — Ottawa. — An interesting debate took place on January 29th in the Dominion Parliament on the Government Bill to regulate the exportation of electrical power, &c., which has now reached the committee stage. Mr. W. F. Maclean complained that the Bill did not contain any provisions which would prevent the exportation of power to the United States by some of the companies now operating in Canada. He favoured the prohibition of exportation from Canada of electrical energy, which should be kept for the use of the railways and other enterprises contributing to the development of the Dominion. One company now operating in Canada, the Ontario Power Co., had already spent $4,000,000 on transmission lines in the United States, but had not invested $1 for similar service in Canada. The Rankin Co. had also contracted to export 90,000 H.P., and the Bill would not, he contended, touch either of these companies. The Niagara Falls Co. was making no effort to supply Canadian consumers, and the Electrical Development Co. was seeking powers to export power. Under these circumstances, he would ask whether, following the recommendation of Canada's own commissioners, there was anything in the Bill to protect the public interests in Canada. He advocated the imposition of a sufficient export duty to control existing organisations, or any big merger which it was rumoured might be formed. The Minister in charge of the Bill pointed out that the Bill specifically stated that only surplus power might be exported, and that under licence, which might be revoked, should any company fail to supply a fair quota to meet the Canadian demand. If there was a market for power in a foreign country, there was no reason why power should not be exported, after the demand of the home consumer had been met. The provisions of the Bill would be applicable to the existing companies as well as to those incorporated in the future. Mr. Cockshutt took exception to the Minister's estimate of the market for Niagara power. Within a radius of 125 miles of the Falls, there was a demand for 100,000 H.P. Mr. Bristol thought that before the companies were called upon to install expensive plant, it was only reasonable they should have some idea as to the length of licences and the amount of power which they would be permitted to export. He suggested that it would be wise to place a time limit on the licences, and that before the licences were put into effect, there should be an investigation as to the amount of power that could be reasonably used in Canada during the period in question, so that the people of the Dominion would have the benefit of any doubt. With regard to the clause which enabled the Minister to fix the price of electrical power in Canada, he pointed out that the Province of Ontario had agreements with certain companies for the development of electricity at Niagara Falls, and thought that in the circumstances it would be wise to consult the Provincial Government of Ontario in the matter. Mr. Lancaster, in opposing the Bill, contended that Canada must protect herself. The Minister in charge of the Bill stated that the policy of the Government was to retain in their own hands power to regulate the prices at which electric energy could be supplied to the Canadian consumer, and, while endeavouring to protect the interests of the consumer, to extend protection to the interests of capital, and not to allow themselves to be stampeded by silly newspaper contentions and outcries against huge and aggressive companies. There had been from first to last the best of understanding and co-operation between the Government of Ontario and the Dominion Government in regard to the Bill. The intention was that the Government would not be satisfied without an inspection of the books of the company to ascertain what amount of electrical energy was exported. The Bill carried out the principle that only the surplus of power after Canadian requirements had been met should be exported. Replying to a member, the Minister stated that by United States legislation, the import of power from Canada was limited to 160,000 H.P., but the full amount was not yet being exported. The Bill was advanced a further stage, and the House went into Committee on the various clauses.

German Competition from the Teutonic Point of View.—The complaints made in England regarding German competition have induced a prominent expert in the German electrical industry to publish a statement which purports to represent the Teutonic point of view on the question. In the first place, it is stated that the assumption put forward that the imposition of import duties would seriously hamper foreign competition is as incorrect as the supposition as to the causes of foreign rivalry—namely, cheaper continental labour conditions, the selling of goods below the proper prices, &c. The statement, which was published by the Berlin *Tageblatt*, proceeds to refer to the early days of electrical work in England, and submits that the financial crashes of that period dissipated any interest which the public might have even for manufacturing businesses. In the meantime, the German industry was being inaugurated slowly and with caution. The large firms began to construct normal or standard types of machines in order to be able to turn out any kind cheaply and on a large scale. In England, however, the old system was departed from, and makers built single machines to meet the wishes of some consulting engineers. From that time inquiries in England have been for all sorts of machines of abnormal type, which naturally cannot be produced at the prices of standard classes. But in those cases where the great principle of bulk production is followed the English maker is as competent as he was prior to the industrial development of Germany. As an instance, the expert cites the Tangye pumps, which have been bought all over the world notwithstanding protection and even almost prohibitive duties. Similarly the German makers find it possible to compete in most countries even in the face of high freights and import duties. But it cannot be said that these German firms are able to show such sales in England, as compared with their transactions in other countries. The national sentiment in England forms, without any doubt, a great and effective protection for English industry, and the cases where a foreign company has obtained an order for a tramway or power station are of such seldom occurrence as not to be worthy of mention; whilst the cable business is in the hands of a syndicate, and the municipal Councils do not want any foreign tenders. The only branches in which the competition of German electrical firms has specially made itself felt recently are in mining, iron and steel works, the textile industry, &c., special and difficult problems of winding and lifting machinery, pumping, rolling trains and the driving of looms; and in these cases the question of price is not the most important consideration. For years the Germans have devoted special attention to these branches in all their details, and they have thus obtained an advantage of many years' work over England and America in the technical execution of such installations, so as to solve every problem met with in these industries. The expert proceeds to observe that the first serious mistake made by England was the introduction of the Trade Marks Act, imposing notification of the origin to be affixed to foreign goods, and thus causing purchasers to buy direct and not through England. In his opinion the discussions as to the causes of competition between England and Germany are based upon a totally erroneous comprehension of the existing situation. The truth is, he declares, that England has ceased to be the sole industrial country; but it is, and remains, the clearing house of the world. This position has in itself a far higher importance and greater influence, and, at the same time, requires increased and less fluctuating profits. In this respect it is the most intimate interest of England to obtain the best qualities, and to buy them in the cheapest market. In conclusion, the expert remarks that it is best for England that the industries of other countries should remain

capable of efficient production, in order that the former country may constantly be able to expand and increase its business, and furnish its customers with the best goods from the cheapest market.

A Blast-Furnace Gas Power Installation.—Though Germany and Belgium have made great and rapid progress in utilising the waste gases of their blast furnaces, but few firms in Great Britain have taken the question seriously in hand. For some three years the firm of Sir Alfred Hickman, Ltd., of Ettingshall, Wolverhampton, have been using their waste gases for blowing and for power purposes. This firm purchased the large blowing engine which was on view at the 1900 Paris Exposition, and it is now working the blast furnaces or assisting the steam blowing engines. Another large blowing engine of 1,000 H.P. with positively actuated air valves has been supplied by the Premier Gas Engine Co., of Sandiacre. It has now been at work for 2½ years, and the cylinder is in perfect condition internally, smooth and free from scratches, and has not worn a sixty-fourth of an inch. The Premier Co. have also supplied them with other engines of 500 H.P. for power purpose, which are driving electric generators by means of ropes. The foundation is down ready for an engine of much larger size, which will soon be erected so that, including also a Crossley engine which has been some time at work, this ironworks is employing, or soon will be, some seven or eight engines using blast furnace gas. No trouble appears to be experienced from dust. The crude gas from the furnaces is passed through depositors and scrubbers which get rid of the major portion of the dust, but there is even then a fine residue of dust still remaining which must not be allowed to enter the engines. This fine dust gets through all ordinary cleaners, and it is necessary to get rid of it dynamically. For this purpose the gas is passed through fans, which rotate at a high velocity and put the gas into a state of intense whirling movement. The dust, which is of greater specific gravity than the gas which carries it, is thereby endowed with a centrifugal or tangential energy superior to that of the gas, the mere difference of specific gravity being intensified by movement. The dust is thus flung outwards upon the fan casing. Into the side of the casing water jets are admitted. These are caught by the fan blades and sprayed through the gas and forcibly dashed on the circumference of the casing, thoroughly wetting the dust and washing it down, as well as keeping clean the fan blades. The dirty water escapes from the lower part of the fan casing by way of a water seal, and flows away and may be used again after passing a settling pond. At the above works three of these fans are placed in series, from the first of which the water flows away black in colour, but from the third it escapes very little discoloured, showing that the dirt and dust have been got rid of in the first two fans. The progress of the last engine has been somewhat delayed by the fire which destroyed the roof of the engine room and damaged the engines considerably, but the damage has now been mostly made good. Though the load on the power engines is very variable, as shown by the wide fluctuation of the ammeter, the voltmeter needle remains steady with a scarcely perceptible vibration, and the whole installation is a proof of what the gas engine will do in steady driving. We note that the Premier Gas Engine Co. adhere to the use of a scavenging charge. They find that by its means they get a much greater power from a given cylinder and perfect freedom from back firing. This is particularly noticeable in comparison with the Belgian engine, which frequently back fires, resulting in serious slowing down of the speed of this big engine, a matter of comparatively small importance in one of several blowing engines, though quite inadmissible with an engine doing electrical work.

Pyrometers.— Formerly the manufacturer depended entirely on the trained eye of a workman for the regulation of the temperature at which his processes were carried out, and, as a consequence, the acquired knowledge departed with the workman. On the other hand, it is necessary now to establish a series of temperatures, by means of a pyrometer, for the most economical working, and this constitutes a permanent record and can be duplicated at all times. Such a rational procedure has been utilised almost universally in the steel trade of America, and, to a smaller degree, in Europe. Its advantages over the older rule-of-thumb methods are at once obvious, for the personal element is entirely eliminated. The pyrometer in its original form, was discovered and made use of by Le Chatelier, who employed a two-metal contact as the source of an electric current. According to a well-known law, different current strengths are developed for different temperature differences at the point of contact, and this simple device may be used in the place of the most sensitive form of thermometer. This type of apparatus is still very largely in use to-day, development having been made chiefly in the form and the method of recording. The recorder has in many cases been a real difficulty to overcome, for the currents to be measured are so small that a pencil attachment on the recording arm would offer too great a resistance for such work as requires a high degree of accuracy. This has been overcome in a new form, due to Bristol, in a very ingenious manner. The recording arm, instead of being dragged along a chart, is compelled to make a series of dots, caused by a suitable vibratory motion, reducing, in this manner, the resistance to a minimum. For the instant determination of the temperature of molten metals, Bristol employs an interesting modification of the old thermo-electric couple, the wires at the hot end being left separated. The couple is dipped into the bath and makes contact with the two elements, completing the circuit and immediately indicating the temperature on a recording chart. When the couple has worn away to a length of about 1 ft., the fire end is replaced by a new one. Another type, entirely different from the former, is that in which the varying resistance of a metal at different temperatures, is employed as a thermometer. These have a very wide range, and can be used at a temperature of 2,200° F. They are extremely sensitive, and respond very quickly to temperature changes. These can be placed in inaccessible positions and read from a considerable distance. So sensitive is the Whipple form, that every change in temperature due to the feeding of the furnace can be read with ease. In fact, it might be used in this connection to discover an inefficient stoker. In the Brown form the varying expansion of two different substances is employed as the temperature indication, and can be used up to 1,500° F. Inside a steel tube are graphite rods, having practically no expansion, and the indication of the instrument is caused by the difference in expansion of the outer seamless drawn-steel tubing and the graphite rods. Above these rods is steel tubing with pieces of brass, by which the instrument is accurately compensated, for various insertions in the heat. In the head of the instrument is a multiplying movement to magnify the indication. In the Price form the old couple action is made use of in various modifications. The wires are insulated in fireclay, porcelain or asbestos tubes depending on the temperature required. For very high temperatures a further protective case is used. In such cases platinum, iridium and rhodium are the only metals possible, and these are coupled two in series to obtain greater precision. In this type the cold end of the couple need not extend far from the heat, but may be joined there by certain wires of a metal, which develop a counter E.M.F. equal to that set up by the cold end. In this instrument the indication is made by means of a spark from the recording arm, through a continuous sheet of paper to a contact below. Last of all, there is the radiation pyrometer which has now been made into a continuous recording instrument. In the Féry type the total radiation in connection with the Stefan-Boltzmann law is made use of and employed to indicate varying temperatures. —*Electro-Chemical and Metallurgical Industry.*

Glasgow Contractors' Dinner.—The fourth annual dinner of the local branch of the Electrical Contractors' Association was held in the Grosvenor Restaurant, Glasgow, on 21st inst., with Mr. William M'Whirter in the chair.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The annual staff dinner of the Croydon Corporation electricity works was held recently under the presidency of Mr. ALEX. C. CRAMB (borough electrical engineer). The guests included the Mayor (Councillor Keatley Moore), and members of the Lighting and Electricity Committee. Mr. Cramb referred to the new metallic filament lamp, which would reduce electricity bills by one half. This would mean diminished revenue for them, but the public would want more light. Regarding their opponents, the gas companies, the latter had the advantage of a free hand in every respect, being able to fix fittings and maintain mantles. They (his hearers) were a little bit sore about it, and the fight against this competition was harder than the ratepayers knew. Regarding a recent offer of the gas company to light a portion of the town free for six months to show the superiority claimed for gas over arc lighting, Mr. Cramb said the company would put up the latest modern high-pressure lamps, and then compare them with arc lamps fixed eight years ago, and now being replaced. He recommended ratepayers to note the quality of by-street gas lighting. Councillor Betteridge (acting chairman of the Committee) expressed the great confidence the Committee had in Mr. Cramb, and his assistant, Mr. Burr.

The Hanley T.C. has increased the salary of Mr. C. H. YEAMAN, the electrical engineer, from £320 per annum to £350, with annual increments of £10 to £400.

The staff of the Heckmondwike Electricity Works held their annual supper on 21st inst. commencing at 12.30 a.m. Mr. G. H. Carter, Consulting and Resident Engineer, presided and gave a short speech on the growth of the station. After supper the early hours of morning were spent in smoking, and songs, &c., were rendered by members of the staff. All passed off satisfactorily, though we are informed that Mr. C. Radcliffe, switchboard attendant, composed an ode on the station staff.

The Cardiff Electrical and Tramways Committee, on Friday, appointed Mr. C. G. M. NEW, General Assistant to Mr. ARTHUR ELLIS, Electrical Engineer, as Deputy Electrical Engineer, at a salary of £200 per annum, rising by £10 a year to £250.

Tramway Officials.—MR. J. W. HUDSON, chief inspector of the Nelson tramways, has been appointed manager of the Todmorden Corporation motor-'bus department.

General.—MR. D. O. EVANS, manager and engineer for North Wales for the National Electric Construction Co., Ltd., has transferred his office from Bangor to the electricity works, Carnarvon, to which address all business communications are in future to be sent.

The *British Australasian* says that Mr. B. DEACON, engineer and general manager of the Electric Supply Company of Victoria, has returned to Australia from a seven months' trip to England.

Mr. J. F. Watts who has represented Messrs. Siemens Brothers, in Birmingham and the Midlands for the past 3½ years, is leaving that district to take up a position at Messrs. Siemens Brothers' Dynamo Works, Ltd., Westminster.

Mr. A. Hart, who was for nearly nine years works manager to Messrs. Bruce Peebles & Co., Ltd., has now started business on his own account as electrical engineer and contractor, making a speciality of repair work, re-winds, renewals, &c., for which he has a suitably equipped workshop, and will trade as A. Hart & Co., electrical engineers, Bonnington, Edinburgh. On leaving his old firm, the staff presented him with a silver-mounted tantalus, and Mrs. Hart with a silver kettle.

We learn that the following "Simplex Conduit" representatives have been awarded the Collaborateur Medal at the Milan Exhibition:—Mr. L. N. Waterhouse, managing director; Mr. B. H. Howell, the Co.'s late controlling agent for Europe; and Mr. Nicola Romeo, the Co.'s Italian agent.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Marconi International Marine Communication Co., Ltd. (London) (65,759).—Issue on February 8th of £4,000 7 per cent. debentures, part of series created November 20th, 1905, to secure £25,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £16,000.

Consolidated Supply Co., Ltd. (85,838).—This company's annual return was filed on January 29th, when 25,000 ordinary and 17,017 preference shares had been taken up out of a nominal capital of £50,000 in 25,000 ordinary and 25,000 preference shares of £1 each. £1 per share has been called up on 1,517 preference, and £1,514 10s. has been paid. £2 10s. remains in arrears. £40,500 is considered as paid on 15,500 preference and 25,000 ordinary. Mortgages and charges: £12,500.

Adelaide Development Co., Ltd. (64,393).—This company's annual return, made up to December 31st, was filed on February 11th. The entire capital of £42,500 in £10 shares has been taken up. £10 per share has been called up on 3,700, and £3 per share on 250 shares, resulting in the receipt of £37,750. 300 shares are considered as fully paid. Mortgages and charges: Nil.

Lumb Electrical Bleaching Co., Ltd. (91,562).—Issue on February 7th of £800 5 per cent. debentures, part of series created January 18th, 1907, to secure £15,000, charged on the company's undertaking and property, present and future, except uncalled capital. No trustees. Previously issued of same series: £14,200.

Issue on February 7th of £1,500 6 per cent. second mortgage debentures, part of series created January 18th, 1907, to secure £15,000, charged on the company's undertaking and property, present and future, except uncalled capital. No trustees. Previously issued of same series: £11,725.

New Ignition Syndicate, Ltd., London (91,175).—£600 6 per cent. debentures, created January 17th and dated January 25th, charged on the company's property, present and future, including uncalled capital, have been registered. No trustees.

St. Austell and District Electric Lighting and Power Co., Ltd. (66,382).—Issue on February 11th of £550, and on February 12th of £100 5 per cent. debentures, part of series created June 1st, 1904, to secure £2,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £1,000.

Electric Carriage and Storage Co., Ltd. (73,476).—This company's annual return was filed on December 31st, when seven shares had been taken up out of a nominal capital of £100 in £1 shares—£7 had been received. Mortgages and charges: Nil.

British Electric Light Wiring Co., Ltd. (58,013).—This company's annual return was filed on January 15th, 1907, when 156 shares had been taken up out of a nominal capital of £10,000 in £1 shares; £1 per share has been called up and £152 10s. has been received, leaving £3 10s. in arrears. Mortgages and charges: Nil.

Anglo-Spanish Electricity Co., Ltd. (62,655).—This company's annual return was filed on January 18th, when seven shares had been taken up out of a nominal capital of £100 in £1 shares. Nothing has been called up. Mortgages and charges: Nil.

Private Wire and Telephone Installation Co., Ltd. (76,888).—This company's annual return was filed on January 9th, when 3,807 shares had been taken up out of a nominal capital of £10,000 in £1 shares; £1 per share has been called up and paid on seven, and £3,800 is considered as paid on the remainder. Mortgages and charges: £5,500.

Engineering Instruments, Ltd. (66,427).—This company's annual return was filed on December 17th, when 15,000 ordinary and 12,500 deferred shares had been taken up out of a nominal capital of £50,000 in 37,500 ordinary and 12,500 deferred shares of £1 each. £1 per share has been called up on the ordinary and £15,000 has been received. 12,500 deferred shares are considered as fully paid. Mortgages and charges: £3,000.

Perth Electric Lighting Co., Ltd. (55,898).—This company's annual return was filed on February 8th, when seven shares had been taken up out of a nominal capital of £1,000 in £1 shares. Nothing has been called up. Mortgages and charges: nil.

John M. Kaiser, Ltd. (electrical engineers, Birmingham), (91,938).—A £100 5 per cent. debenture, dated January 30th, 1907, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder: S. F. Wright, 39, Corporation Street, Birmingham.

Zono Dynamo and Motor Patents Co., Ltd. (79,568).—This company's annual return was filed on January 10th, when 1,207 preference and 600 ordinary shares had been taken up out of a nominal capital of £2,700 in 1,800 preference and 900 ordinary shares of £1 each; 5s. per share has been called up on 1,200 preference and £1 per share on seven preference, resulting in the receipt of £307; 600 ordinary are considered as fully paid. Mortgages and charges: Nil.

Electric Power Development Co., Ltd. (82,604).—This company's annual return, made up to December 31st, has been filed; 462 shares have been taken up out of a nominal capital of £50,000 in 500 shares of £100 each; £85 per share has been called up, resulting in the receipt of £39,195; £75 remains in arrears. Mortgages and charges: Nil. (Original capital £25,000 in £100 shares. Increased February, 1905.)

Delagoa Bay Development Corporation, Ltd. (76,099).—This company's annual return was filed on January 7th, when 267,400 shares had been taken up, in addition to 40 forfeited, out of a nominal capital of £300,000 in £1 shares. £1 per share has been called up on 177,440, resulting in the receipt of £177,440, including £40 on forfeited shares. 90,000 shares are considered as fully paid. Mortgages and charges: £180,000.

Lindsey Light Railway Syndicate, Ltd. (82,631).—This company's annual returned was filed on January 14th, when £2,200 shares had been taken up out of a nominal capital of £10,000 in £1 shares; 10s. per share has been called up on £993 5s. on 1,200, and £1 on seven, resulting in the receipt of £803 10s. Mortgages and charges: nil.

D. Santoni & Co. (1906) Ltd. (electrical engineers, London), (89,277).—Issue on February 25th of £1,000 6 per cent. debenture, part of series created February 19th, 1907, to secure £2,000 charged on the company's business and other assets, present and future, including uncalled capital. Holders: Barclay & Co., 24, Southwark Street, S.E. No trustees. No previous issue of same series.

Copingers, Ltd. (90,438).—This company's annual return was filed on February 16th when 787 shares had been taken up out of a nominal capital of £2,000 in £1 shares. £1 per share has been called up on 37, and £37 has been received. 750 shares are considered as fully paid. Mortgages and charges: Nil.

City of Ely Electric Light and Power Co., Ltd. (85,444).—This company's annual return was filed on December 31st, when 3,003 shares had been taken up out of a nominal capital of £5,000 in £1 shares. 2s. per share has been called up, and £300 6s. has been received. Mortgages and charges: Nil.

Witting, Eborall and Co., Ltd. (71,038.)—This company's annual return was filed on January 5th, when the entire capital of £40,000 in 1,150 "A" and 850 "B" shares of £20 each, had been taken up. £4 per share has been called up on the "B" and £3,400 has been received. £23,000 is considered as paid on the 1,150 "A" shares. Mortgages and charges: Nil.

Hyderabad Electric Light and Traction Co., Ltd. (80,635).—This company's annual return was filed on January 24th, when 27 shares had been taken up out of a nominal capital of £10,000 in £1 shares. £27 has been received. Mortgages and charges: Nil.

Engineering Instruments, Ltd., London (66,427).—Issue on February 15th of £300 5 per cent. debentures, part of series created November 30th, 1906, to secure £5,000 charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of the same series: £2,110.

British Columbia Electric Railway Co., Ltd. (51,953).—A trust deed dated February 23rd, 1907, securing perpetual consolidated debenture stock not exceeding the amount paid or credited as paid on the capital for the time being issued (the deed being stamped to cover £300,000) has been registered. Property charged: The company's undertaking and property, present and future, including uncalled capital. Trustees: British Empire Trust Co., Ltd., 31, Bishopsgate Street, Within, E.C.

James & Browne, Ltd. (electricians, &c., Hammersmith), (72,372).—Issue on February 20th of £400 5 per cent. debentures, part of series created June 29th, 1906, to secure £6,000, charged on the company's undertaking and property, present and future, including uncalled capital. Trustees: J. W. Ellis, Portland House, Basinghall Street, E.C.; and E. Hughes, 106, Holland Road, Kensington. Previously issued of same series: £3,840.

CITY NOTES.

Metropolitan Electric Tramways, Ltd.

The directors' report for 1906 states that the total revenue from all sources amounted to £242,883, but out of this sum they are reserving until next account £27,476, being one-half of the dividends received from the North Metropolitan Tramways Co. during that year. The traffic receipts amounted to £179,600, showing a satisfactory increase of £39,560. The profit and loss account shows a net credit balance of £39,743, after providing £8,270 for renewals and reconstruction, and writing down preliminary expenses and other items by £3,233. Adding the amount brought forward from 1905, there is a total of £44,445 to be dealt with. Out of this there has been paid the dividend of 5 per cent. for the year on the preference shares, amounting to £25,000. The directors recommend that a dividend of 4 per cent be paid on the ordinary shares for the year, and that the balance of £3,791 be carried forward.

In March, 1906, the company issued £76,200 debenture stock as fully paid in exchange for the like amount of 3½ per cent. debentures in the North Metropolitan Tramways Co. This stock carries interest at the rate of 3½ per cent. per annum up to and including December 31st, 1908, and thereafter at the rate of 4½ per cent. per annum. The debentures so acquired have been surrendered and cancelled, the company's liability to the North Metropolitan Tramways Co. in respect of the balance due on the purchase price of the Middlesex Tramways being correspondingly reduced. A further £2,300 North Metropolitan debentures have been acquired by purchase in the market and cancelled. At the close of the year the company's indebtedness in respect of these debentures stood at £52,700. At December 31st, 1906, the issued capital of the company was:—

£500,000 in 5 per cent. cumulative preference shares of £1 each, fully paid.
£391,337 in ordinary shares of £1 each, fully paid.
£314,016 in deferred shares of £1 each, fully paid.
£350,000 in 4½ per cent. debenture stock, and
£76,200 in 3½ per cent. debenture stock.

On March 31st, 1906, the North Metropolitan Tramways Co. surrendered to the L.C.C. the lease of the Council's Northern Tramways. A return of capital out of the proceeds of the surrender, amounting to £3 10s. per share, was authorised by the shareholders of that company in July last, and since the close of the year has been sanctioned by the Court and paid. The proceeds have been applied in paying off the temporary loans of £220,759 appearing in the balance-sheet, and providing for the redemption of the outstanding 3½ per cent. debentures of the North Metropolitan Co. The company received dividends from the North Metropolitan Co. of 14s. per share for the year.

During the year the reconstruction of the Harrow Road and Paddington tramway has been completed, and further light railways have been electrically equipped and opened for public traffic. The following statement shows the mileage of lines in operation at December 31st, 1906:—

	M.	F.
Tramways and light railways opened prior to 1906	22	2
Harrow Road and Paddington Tramways (opened December 22nd, 1906)	2	4
County of Middlesex light railways, as under—		
Cricklewood to Willesden Green (opened March 31st, 1906) ..	0	4
Wood Green to the Alexandra Palace (opened April 11th, 1906)	1	0
North Finchley to the Hertfordshire boundary (opened August 4th, 1906)	0	6
Harlesden to Stonebridge Park (opened October 10th, 1906) ..	1	4
Wood Green to Bowes Park (opened November 28th, 1906) ..	1	1
	29	5

New lines are being constructed by the County Councils of Middlesex and and Hertfordshire, and it is anticipated that 6 miles of extensions will be opened during the present year. The new depôt at Stonebridge Park, which was completed in the autumn, will accommodate all the cars required for working the Harrow Road tramways and the adjacent light railways opened and under construction. Forty new cars have been purchased, bringing the company's stock to 190. The Manor House depôt is being converted into store rooms and offices for the company's traffic and engineering departments.

The following Light Railway Orders, authorising the construction of lines to be worked by the company, have been confirmed and issued by the Board of Trade:—

Order.	Owner.	Mileage authorised. M.	F.
Watham Cross and Enfield ..	The Middlesex County Council ..	4	6
Cheshunt	The Hertfordshire County Council	3	4
Tottenham and Walthamstow	The company	1	4
		9	6

A serious accident occurred in June, 1906, on the Highgate Archway tramway, resulting in three deaths and injuries to other persons. The whole of the pecuniary loss is covered by insurance. An agreement has been made with the L.C.C. by which the company's Stamford Hill tramway will not be purchaseable by the Council under the Tramways Act, 1870, until 1930. An agreement made with the Hornsey Corporation and the L.C.C., varying the dates at which certain small portions of the tramways in London and Middlesex belonging to the company are purchaseable under Sec. 43 of the Tramways Act, 1870, has been confirmed by Parliament. Under this arrangement the company will have a terminus at Manor House, in the County of London, until the year 1930. Under the terms of an agreement made by the Harrow Road and Paddington Tramways Co. with the Willesden U.D.C., the company were precluded from opening the purchased tramway with electric traction without the consent of the Council until the agreed street widenings had been completed. An agreement has been made which has enabled the company to open the lines pending the completion of the widenings.

The company's investment in the North Metropolitan Electric Power Supply Co., inclusive of loans, amounted at December 31st last to £380,988. It is yielding an encouraging return, and the directors consider that the business of electric power supply is developing satisfactorily. The revenue from the sale of energy was £43,686, an increase of £11,420 upon the preceding year.

Under the powers obtained in their Act of 1905, the Power Supply Co. have acquired by transfer from the local authorities concerned, the electric lighting orders of Tottenham, Edmonton and Kingsbury, and the distributing mains are shortly to be laid in the two former districts. Negotiations are in progress with various local authorities and other parties either for the supply of power in bulk or for the transfer of lighting orders.

A Bill is being promoted by the Power Supply Co. in the present session of Parliament, primarily to defend its interests against the threatened encroachments of the L.C.C. (Electrical Supply) Bill, as deposited, and for general purposes. Electricity is being supplied in Barnet, Hertford and Enfield, and lighting orders for the districts of Cheshunt, East Barnet Valley, Ware and Wealdstone have been obtained, and an agreement has been made with the Wembley U.D.C. to take over the lighting order obtained by that authority.

Year ended Dec. 31, 1905.		Year ended Dec. 31, 1906.
22·25	Miles open	29·625
28,842,989	Number of passengers carried	36,318,774
3,286,712	Number of car-miles run	3,975,463
10·22d.	Average receipts per car-mile	10·84d.
1·17d.	,, ,, ,, passenger	1·18d.
150	Number of cars in stock	190

The Greenock & Port Glasgow Tramways Co.

The ordinary general meeting of this company was held at Donington House, W.C., on Monday, Mr. F. W. Chanter presiding.

In moving the adoption of the report, the Chairman said that the past year had not been an entirely satisfactory one viewed from the point of view of profit. They would notice that there had been a large expenditure on the permanent way. Prior to last year the whole of the company's obligations with regard to the upkeep of the roads in the Burgh of Greenock had been undertaken by the local authority—that was to say, they had for a fixed annual payment undertaken to carry out all the necessary repairs to the roads within the tramway area, the care of the rails, of course, remaining with the company. When that scheme was first entered into it appeared to be an ideal arrangement, as the Tramway Act stipulated that the upkeep of the roads where the trams ran was to be to the satisfaction of the Corporation, and to escape from that uncertain obligation appeared to be eminently satisfactory. Practice, however, had shown that the arrangement was unworkable. For example, the company had from time to time had to contend that the Corporation were not maintaining the road surface in such a state as to protect their rails and their substructure from depreciation. The Corporation, on the other hand, contended that the rails were loose and damaged the paving. After considerable negotiations the arrangement had been cancelled. The Corporation had paid to the company the sum of £1,125, and relieved them from the obligation to pay the £450 a year for the upkeep of the road surface. The company had now, therefore, complete control over the roads along which their tramways were laid, and they anticipated much easier working in the future. The whole question of the permanent way of the company's system was a difficult one The street traffic in Greenock and Port Glasgow was abnormal both in quality and quantity. The heavy lorries that went along the roads seemed to have a partiality for their tramways, and the traffic had a marked effect on the life of the track, as compared with what might have been expected under less onerous and more normal conditions; and it had been found necessary, as had been anticipated by their late chairman, to carry out during the period under review a considerable amount of renewals to the permanent way, including the replacing of nearly two-thirds of the points and crossings by others of new and improved design. The cost had been considerable, but owing to the improved receipts, and by careful economy in working, a good part of that expenditure had been met out of revenue. They had, however, had to dip considerably into the fund that had been accumulating during the past few years for such a purpose, and considerable further expenditure would be incurred during the next few years to complete the renewal of points and crossings and improve the lines in order to obtain efficient and economical working. Referring to the accounts, they would note that the depreciation and renewals account had been reduced by £3,340 The reserve (sinking) fund, after adding the amount they proposed to place to that fund this year, stood at £9,540, which was, to a considerable extent, invested outside the business. The capital outlay on the old lines remained practically at the same figure as last year. There had been an expenditure on electrical reconstruction of £4,750, principally in the acquisition of further cars which were necessary for their extended service, and in adding top seats to some of the smaller cars, and also on feeders, the latter having been found inadequate to the increased traffic. The traffic receipts had increased by £1,200, and they had carried over 175,000 more passengers. The receipts per passenger, 1·05d., were unusually low, and that was accounted for by two reasons. In the first place the existence of ½d. fares throughout the whole of their system, and secondly, the abnormal amount of workmen's traffic. On many systems the workmen's traffic was carried on at a loss, but at Greenock they had found that it had paid to extend the facilities in that direction. There was a small decrease in the power and running expenses, which was most satisfactory in view of the increased number of passengers they had carried. The balance carried to profit and loss amounted to £8,589 which added to the sum of £276 brought forward, amounted to a total of £8,868. The directors recommended that £1,780 should be placed to the reserve (sinking) fund, the payment of a dividend at the rate of 5 per cent. on the preference shares which would absorb £3,500, a dividend at the rate of 3 per cent. on the ordinary shares which would absorb £3,450, leaving a balance of £126 to be carried forward.

Mr. H. S. Day seconded the motion, and the report was adopted.

Sunderland and District Electric Tramways, Ltd.

The report states that the accounts show a period of operation of the tramways from June, 1905, to October, 1906, of which term the last five months represented operation under more or less normal conditions, the earlier part of the period being hampered by the difficulties of construction—the system not having got into full working order. The company's operating profit was £7,175, to which must be added the proportion of royalties for three months amounting to £289. The receipts for the six months ended December 31st, 1906, show an increase of £3,143 over the corresponding period of the previous year. The directors have completed the arrangements for disposing of their rights to supply power in the area covered by their order to the Durham Collieries Electric Power Co., Ltd. Under these arrangements this company receives a fixed royalty of £1,000 per annum, commencing from August 1st, 1906, and a further royalty on electricity supplied to persons other than the Sunderland District Electric Tramways, Ltd. A further arrangement has been entered into under which the Durham Co. undertakes to supply this company with the power requisite for the operation of this company's tramways at a fixed rate. Mr. C. S. Cockburn (deputy-chairman of the Lancashire, Derbyshire and East Coast Railway) has joined the board as chairman. Owing to ill-health Sir Riley Lord (the chairman) retired from the board, and the directors have elected the Hon. Reginald Parker and Mr. A. U. Greer to seats on the board.

The ordinary general meeting of this company was held on Friday last at the Great Eastern Hotel, Bishopsgate, E.C., the Hon. R. Parker presiding.

The Chairman, in proposing the adoption of the report, explained that the meeting had been somewhat delayed in order that they might be able to show a fair period of the working of the tramways under normal conditions. They first commenced operating the tramways in June, 1905, by current which was supplied in a somewhat spasmodic fashion, owing to the difficulties experienced in obtaining the completion of the Durham Electric Power plant, from which it had been arranged they should ultimately obtain their power. The period of regular operation did not really commence

until the end of May, 1906, so that approximately there had been only about five months' normal working in the accounts now presented. At the former meeting they were told by the previous chairman that the company had made arrangements under which they were to transfer their rights to supply power in their area to the Durham Collieries Electric Power Co., Ltd., in return for the payment of a fixed royalty from the power supplied to users. They also entered into a contract to take from that company all the power necessary for the operation of their tramways at a fixed rate. Those arrangements enabled them to obtain power at a fixed cost, and were, in the opinion of the directors, advantageous to the company. About 20 months ago he (the chairman) was invited by some of the large shareholders to join the board, and he then went carefully into the position and prospects of the company, and satisfied himself on an inspection of the district and of the undertaking that the company would eventually earn satisfactory dividends upon its capital. The Durham Power Co. commenced supplying them with current from the end of May last year, but their power station was not complete, and the supply was not altogether satisfactory until August. In the light of later events, it would undoubtedly have been better had they postponed the opening of the tramways for six or eight months. He was pleased to say that with the exception of the last mile under contract, which was the piece of line from Eastington Lane to South Hetton, the whole tramway was now completed, and that last mile would not be undertaken unless the directors felt satisfied that the traffic receipts would justify the necessary capital expenditure. Turning to the revenue, their receipts showed a satisfactory expansion. The district served by the tramways was peopled almost entirely by miners, and at first they did not seemed disposed to avail themselves of the travelling facilities the company were offering them, but that was usually noticeable in all cases of new locomotion. As showing how the receipts were increasing, he might mention that while for the months of August, September and October, 1905, the receipts amounted to £4,290, for the corresponding months last year they had risen to £6,889. The operating profit was £7,175, and the net profit for the period under review—from June, 1905, to October, 1906—was £3,527. Although the earnings during the experimental stage of the company's running proved insufficient to meet the whole of the debenture interest, the increased receipts upon which they might reasonably count in the future should, under this year's normal conditions, suffice to fully meet that interest, and also provide something for the preference shareholders.

Mr. H. R. Hogg, in seconding the motion, remarked that now they had got through the winter the traffic was improving, and there had been a substantial increase during the last four or five weeks.

The report was adopted.

Victoria Falls Power Co., Ltd.

The Marquis of Winchester presided at an extraordinary general meeting, held last Friday at Salisbury House, E.C., at which the preference shareholders unanimously passed certain alterations in the articles, modifying the rights attaching to the two classes of shareholders. The matter was explained in detail by the solicitor. It was stated that the ordinary shareholders had already agreed to the proposals, which really improved the position of the preference shareholders, inasmuch as the ordinary shareholders did not take 6 per cent. following directly after the preference, but the surplus of profits was to be divided *pro rata* between the ordinary and preference, until the preference got their next 4 per cent. In other words, the two classes ranked together *pro rata* in the additional profits after 6 per cent., until the preference had obtained their additional 4 per cent., making 10 per cent., which was the maximum dividend they got in any case.

The proposal was carried unanimously, and at a subsequent general meeting this and certain other alterations were confirmed. One of these other alterations related to the offices of the company. The company was registered in Rhodesia under the Joint Stock Ordinance of the British South Africa Co., in Rhodesia. One of the advantages of that was that the capital duties on the registration went to support the revenues of the B.S.A. Co., instead of those of the United Kingdom. The bulk of the shares was in this country, and the work done here, and it seemed expedient that whenever notices and proxies had to be lodged, they should be lodged at the London office, instead of in Rhodesia.

Hadfield's Steel Foundry Co., Ltd.

The directors in their report for 1906, which was adopted at the meeting held on March 21st, state that they have added £10,000 to the reserve and renewal account, and carry forward the balance of £20,400. The directors recommend that, in addition to the interim dividend of 1s. per share paid in August last on the ordinary shares (£1 shares) a further dividend be paid on the ordinary shares of 2s. per share, together with a bonus of 2s. per share—all free of income-tax. Admiral Sir Archibald L. Douglas, G.C.V.O., K.C.B., has joined the board.

Calcutta Electric Supply Corporation, Ltd.—The number of units delivered to consumers during the four weeks ended February 22nd, 1907, was 335,574, compared with 244,055 units in the corresponding four weeks of 1906.

Folkestone Electricity Supply Co., Ltd.

The directors' report for 1906 states that the company continues to make satisfactory progress. Up to December 31st, 1905, the equivalent of 76,937 8-c.p. lamps was being supplied, whilst up to December 31st, 1906, the equivalent of 86,871 8-c.p. lamps was being supplied. There is a profit on the revenue accounts of £10,559, which, with the sum of £166 brought forward from last year's accounts, and after allowing for interest on debenture stock, dividend on preference shares and bank charges, &c., and carrying the sum of £2,000 to the depreciation fund, shows a net balance for distribution, after allowing for the interim dividend at the rate of 4 per cent. per annum already paid, of £2,056. Out of this the directors recommend the payment of a dividend at the rate of 7 per cent., less income-tax, for the half-year, making 5½ per cent. for the year, which will require £1,750, thus leaving a balance of £306, which it is proposed to carry forward. As a result of the company's appeal against the rating assessment, a substantial reduction was obtained off the increased assessments made on the company in the various districts. The profit and loss account shows that the sum of £223 is credited to that account, being a refund in respect of rates due for the year 1905 calculated on the increased assessment, and which had been paid under protest. A further issue of £15,000 4½ per cent. debenture stock has been made during the year at 2 per cent. premium; the amount of premium received, less the expenses on the issue, has been credited to a debenture premium reserve fund. The Bill promoted by the company last year in connection with the supply of energy to the Borough of Hythe and the Urban District of Sandgate has passed into law under the title of "The Folkestone and District Electricity Supply Act, 1906."

Statement of Electricity Generated, Sold, &c.

Units generated	1,359,011
Quantity sold.—Public lamps	78,963
By contract	271,336
Private consumers by meter	794,660
Total sold	1,144,959
Used on works	15,311
Total accounted for	1,160,270
Not accounted for	198,741
Public lamps	71
Total maximum supply demanded	938

Direct Spanish Telegraph Co., Ltd.

The meeting of this company was held on Thursday last week, at Electra House, Finsbury Pavement, the Marquis of Tweeddale presiding.

In proposing the adoption of the report (see Electrical Review, March 15th, page 446), the Chairman said he hoped the shareholders would agree with the board in considering the results of the past year as satisfactory. The receipts from traffic showed an increase of £4,952. It was true that part of that increase was due to exceptional circumstances—for instance, the Conference at Algeciras and the wedding of the King of Spain—but, at the same time, the commercial traffic had increased in a very substantial manner—an improvement which continued up to the present time. The expenses were somewhat higher than the year before, the principal items being £417, due to the normal increase of salaries and to the guaranteeing by the company of their employés against fluctuation in the rate of exchange in Spain; and an increase of £339 under the head of stationery, owing to the fact that the stationery in stock on December 31st had been charged to the year in place of being carried over as heretofore. The maintenance of landlines in Barcelona and Cornwall had cost £170 more than in the preceding year. The repairing of faults had been a very costly item. The fault which interfered with the working of the Bilbao cable had cost them £4,724, the whole of which had been charged to the reserve fund. The Marseilles and Barcelona cable, which was put into a thoroughly efficient condition in 1905, had worked admirably. The net result was that they were able to recommend a dividend of 10 per cent. on the preferred shares and 4 per cent. on the ordinary shares. To do this it was necessary to trench somewhat on the reserve fund, which, however, was now higher than the preceding year by a sum of £4,233. The securities in the reserve fund appeared at their cost price. Being gilt-edged securities, there had, of course, been a considerable depreciation, but the board believed that in due time that depreciation would be overtaken, and the securities stand at or above the price they gave for them.

Sir J. Denison Pender seconded the motion, and the report was adopted.

Hastings and District Electric Tramways Co., Ltd.

The ordinary general meeting of the shareholders of this company was held on Friday last at the offices, 1, Queen Victoria Street, Mr. E. C. Morgan presiding.

In proposing the adoption of the report, the Chairman said that when they met last June they had reason to believe that their entire system would have been in operation within about four months from that date. The London Road and Cooden lines were opened for traffic on July 28th, but as regarded the front line, they encountered an obstacle which they had not anticipated. When they were proceeding to construct the permanent way, the gas company claimed that they would interfere with their mains, and called upon them to remove them. This was a demand with which they could not comply, and the question had to be referred to arbitration, which resulted in a decision in their favour, but much time was taken up, and the Front Line was not completed till after December 31st. They were aware that the Front Line was a very important one in their system, not only from the actual receipts which it yielded, but also because it was the connecting link

between the lines in Hastings and those in Bexhill. The delay in its completion, therefore, frustrated their hope of being able to earn the entire preference dividend, and, under the circumstances, they considered it satisfactory that they were able to make a payment on the preference shares at the rate of 4 per cent. They had carried 6,277,941 passengers during the year, or approximately 80 times the entire population of Hastings and Bexhill, which was fairly good evidence that they were supplying a want, and contributing greatly to the convenience of these towns, and he might add that the receipts at present tended to show that the popularity of the undertaking was fully maintained. They actually opened the front line for traffic on January 12th last, and although the running had not so far worked as smoothly as the portions of the system equipped with the overhead trolley, they had no reason to complain of want of patronage, and trusted that ere long they might be able to effect improvements which would abate the adverse criticisms with which the front line had been hitherto assailed. A movement was on foot in Hastings to obtain an extension of their lines through the old town. The difficulties in this direction were due to the narrowness of the streets in this district. It was not impossible, however, to make the extension for which they were asked, provided they were allowed to run a single line through the High Street, which could be done with a minimum of widening, and practically without inconvenience to the inhabitants of the street, and without impinging upon the interesting old buildings there situated. They had had the pleasure of seeing some of the gentlemen interested in this improvement, and had explained to them the situation, with the result that a petition to the Corporation was now being signed in Hastings, requesting them to take up the question, and they were quite prepared, on receiving an invitation through the recognised official channels, to submit plans showing how they could carry out the proposed work. In conclusion, he congratulated the shareholders upon having secured the services of such an excellent manager as Mr. Holliday. In him they had a man of great experience and ability, who had thrown his heart into the work of making the system a success, and had spared neither time nor trouble to do so.

Mr. George Kitchin seconded the motion, and it was carried.

Browett, Lindley & Co., Ltd.

The directors' report for 1906, adopted at the annual meeting held on 22nd inst., states that the year's working has resulted in a gross profit of £10,763 upon work completed, and after providing £1,933 for bank, debenture and loan interest, and writing off £5,793 for depreciation, there remains a net profit of £3,037, to be placed against the loss shown in the last balance-sheet. The amount charged for depreciation is £1,292 more than was charged in the 1905 accounts. Seeing that prices in the early part of last year were the lowest ever taken by the company for high-speed engines, and, in view of the fact that part of the year's production was from a "Corliss" type of engine entirely new to the company, the directors hoped the results would be considered satisfactory. As mentioned in the report for 1905, their high-speed engines had been entirely remodelled and improved in design. These alterations had proved very beneficial, and had now been adapted to most of the sizes hitherto made, but some further expenditure would still be needed to bring all up to date. With their present productions they were able to guarantee the highest efficiency and best steam economies, and all engines which they had supplied of this latest design had given the greatest satisfaction. In consequence of this their tenders had every consideration, and they had received orders from districts where their productions had not previously entered. The order book was now better filled than for some years past, but prices, though slightly better, were still very low; and, in view of the higher cost of all materials, the only method of getting better profits was by increasing the production of the works; this was having the careful attention of the directors. The need of additional machine tools interfered with cheap production, and the directors had under consideration the possibility of acquiring some further tools, which would undoubtedly increase the profits.

The Windsor Electrical Installation Co., Ltd.

The directors' report for 1906 says that during the year 4,941 8-c.p. lamps were added, bringing the total to 39,262, of which 3,206 represent motor power. The capital expenditure amounted to £82,527, being an increase during 1906 of £5,080, the principal addition being the cost of new mains laid in Windsor and Eton, which amounted to £3,635. The installation department was discontinued at the end of March, and is now being carried on by the Windsor and District Electrical Co. The total net profit for the year (including £118 brought forward), was £5,518, against £4,353 the previous year. From the net profit of £5,518 they deducted for debenture interest £760, for depreciation, renewal and reserve fund £1,000, for dividend on preference shares £950, for directors' fees £300, for reserve for bad and doubtful debts £200, leaving a balance of £2,308 available for dividend on the ordinary shares. 4½ per cent. has been paid on these shares for the year, and the balance is carried forward. The directors report the death of Mr. A. H. Thornton; to fill the vacancy thereby created they elected Mr. R. A. Bosanquet, of the Windsor Bank. Mr. H. L. Prior resigned the chairmanship of the company, and Sir William Shipley was elected to that position, Mr. Prior being appointed deputy-chairman. Owing to pressure of business, Mr. Tonman Mosley resigned his seat on the board, but it is not proposed to elect another director in his place at present.

Toronto Electric Light Co.—The annual meeting was held in Toronto on the 12th inst., when the report, which was for the year ended December 31st, 1906, showed an income of $899,578.56, with expenses (including interest on debentures) of $562,847.64, leaving a balance of profit of $336,730.92, or a little over 11·2 per cent. on the paid up capital of $2,997,900. After paying three quarterly dividends at the rate of 7 per cent. per annum, and one at the rate of 8 per cent. per annum, amounting to $217,271.71, a balance of $119,459.21 was carried forward to profit and loss, bringing the total up to $218,057.43. Of that amount $200,000 was transferred to reserve account, which now totals $500,000. A mention was made in the report of the proposed $1,000,000 increase in capital stock to provide for extension of plant. During the past year 62,352 lamps were installed and 2,020 h.p. of motors. It was stated that this increase would be materially increased during the coming year owing to the introduction of Niagara power.

Electrical Development Co. of Ontario.—The fourth annual report of this company shows no statement of profit and loss for 1906, the small amount received from the sale of power being thought insufficient to warrant such; but the President, Col. Sir Henry Pellatt, states that next year he hopes to be in a position to report that the company is earning sufficient to pay the whole of its fixed charges. Through the Niagara Falls Electric Transmission Co., which will act as distributing agent in New York State, franchises are being secured and plans made for extensive exploiting of that State. Of the authorised $10,000,000 bonds there have been issued $8,000,000, while $2,000,000 are still in the treasury, sufficient for completion of present work. The expenditure on plant to the close of the year amounts to $11,341,048 and on transmission lines to Toronto $2,511,850. Reference is made in the report to the agitation for cheap power. The Vice-President states that he has the personal assurance of the Premier of Ontario that while it is the Government's desire and intention to secure for the people of Ontario electric power at fair and reasonable prices, it is conceded that, first of all, a fair and reasonable return is due to those whose faith in this and similar enterprises has induced them to invest their capital in companies.

Shawinigan Water and Power Co.—At the annual meeting of this company at Montreal the Hon. Robert McKay, the president, told the shareholders that the past year was the most successful in the history of the company. The authorised capital of the company is $7,000,000, of which $6,500,000 is paid up. Beginning January 1st, 1909, the company is to deposit with the Royal Trust Co. an amount equal to 1 per cent. of the total amount of bonds then outstanding. This may be applied to redeem the bonds on January 1st of any year.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to:—

British Columbia Electric Railway Co., Ltd.—Scrip (fully and partly paid) for £300,000 4½ per cent. perpetual consolidated debenture stock.

And to allow the following to be quoted in the Official List:—

Sao Paulo Tramway, Light and Power Co., Ltd.—10,000 additional shares of $100 each of capital stock, and $500,000 additional 5 per cent. first mortgage debentures of $500 each, Nos. 11,001 to 12,000.

Greenock and Port Glasgow Tramways Co., Ltd.—The report for 1906 states that the outlay on the electrical construction account was £4,746, making the total £193,124. The revenue for the year was £34,998, and the expenditure £26,408, the latter sum including interest, amounts payable to Corporations, cost of repairs and maintenance, and a provision of £2,250 for depreciation and renewals. There remains a profit of £8,589, to which is added £276 brought forward, making a total of £8,866. The directors recommend that there be placed to reserve (sinking) fund, £1,780; 5 per cent. dividend on the preference shares, £3,500; 3 per cent. per annum on the ordinary shares, £3,450; carried forward, £136. The reserve (sinking) fund now stands at £9,449. The strike of shipyard workers during October and November had a serious effect on the revenue. The arrangement with the Greenock Corporation, under which the local authority took over the company's obligation to maintain the portion of the roads on which the tramways are laid, led to considerable friction, which threatened to become acute, and it has been cancelled. Extensive renewals and improvements have been made in the permanent way during 1906, and £5,590 of this has been charged to depreciation and renewals fund.

Rossendale Valley Tramways Co., Ltd.—The directors' report for the year 1906 shows an increase in receipts of £297. The traffic and general expenses show a slight increase, but substantial reductions have been effected in the other departments. The passengers carried during the year were 1,630,139, as compared with 1,592,065 for 1905, an increase of 38,074. The balance available for distribution amounts to £2,214 as compared with £1,614. It is proposed, after paying 5 per cent. preference dividend, to pay a dividend on the ordinary shares at the rate of 5 per cent. per annum, making 5 per cent. for the year, and to carry forward £823.

Prospectuses.—*Sumatra Para Rubber Plantations, Ltd.*—This company has been offering 50,000 £1 shares for subscription. The company acquires the Pangkattan Estate, which is already producing rubber, the crop during 1906 being 13,419 lbs.

The Pilbarra Asbestos Co., Ltd., has been before the public this week with an issue of 20,000 £1 shares. The company is to acquire rights to work deposits of Chrysotile Asbestos in the Pilbarra district of Western Australia, and to export this and other products.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	*	No. of wks.	Total to date. £	*	Route miles open.	*
†Aberdeen	Mar. 20	2,256	+ 8	42	58,574	+ 1,871	14·4	..
Ayr	„ 16	350	— 35	44	12,700	— 21	8	..
†Bath	„ 23	1,247	— 27	12	7,339	— 280	13	..
Belfast	Feb. 22	6,314	+ 626	8	..	..	40	+ 6½
†Birkenhead	Mar. 17	976	+ 4	50	52,208	+ 812	13·52	..
†Birmingham Corp.	„ 16	5,442	..	50	106,496	..	..	..
†Blackburn	„ 19	929	+ 111	50½	51,079	+ 3,105	13·6	..
†Blackpool Corp.	„ 21	7:8	+ 43	49	53,008	+ 3,748	11·87	..
† „ —Fleetw'd.	„ 16	198	+ 8	10	2,086	+ 59	8·25	..
†Bolton	„ 17	1,999	+ 55	50	105,422	+ 8,226	26	+ 1
†Bournemouth	„ 20	2,619	+ 69	51	81,013	+ 9,808	21·5	+ 2¾
†Bradford	„ 16	3,992	— 9	50	222,627	+ 7,442	53	..
†Brighton	„ 17	708	+ 8	50	47,062	..	9·5	..
†Bristol	„ 22	9,163	— 83	..	..	..	28·5	..
Brit. Elec. Trac. Co.								
Airdrie	„ 15	424	+ 11	10	2,245	— 16	3·65	..
Barnsley	„ 16	322	+ 1	„	1,580	— 28	..	..
Barrow	„ 15	427	— 5	„	2,144	+ 18	5·37	..
Cavehill	„ 15	110	— 13	„	515	+ 40	..	..
Devonport	„ 15	814	— 1	„	4,846	+ 95	8·85	..
Gateshead	„ 15	1,505	+ 47	„	9,852	+ 195	11·25	..
Gravesend	„ 15	427	+ 17	„	2,083	+ 11	6·5	..
Greenock	„ 15	1,193	+ 71	„	5,910	— 3	7·25	..
Hartlepool	„ 15	473	— 42	„	2,447	— 209	6·72	..
Kidderminster	„ 15	176	— 12	„	880	— 78	..	..
Leamington	„ 15	262	— 21	„	1,336	— 44	8	..
Merthyr	„ 15	384	+ 7	„	1,946	+ 107	2·9	..
‡Metropolitan	„ 15	7,526	+1,571	„	37,543	+ 8,350	22	..
Middleton	„ 15	584	+ 3	„	2,921	— 10	8·5	..
Mid. Joint Com'tee	„ 15	12,643	— 635	„	63,132	— 3,512	..	..
Oldham — Ashton	„ 15	1,104	+ 52	„	5,675	+ 335	9·13	..
Peterborough	„ 15	195	— 7	„	986	— 33	5·31	..
Potteries	„ 15	3,615	— 4	„	18,490	+ 60	29	..
Rothesay	„ 15	95	+ 6	„	468	— 11	2·75	..
Southport	„ 15	422	— 29	„	2,079	— 304	8·17	..
S. Metropolitan	„ 15	1,308	..	„	6,414	..	..	..
Swansea	„ 15	1,515	+ 71	„	7,880	+ 369	5·5	..
Tynemouth	„ 15	287	— 45	„	1,477	— 205	3·75	..
Weston-s-Mare	„ 13	51	— 15	„	249	— 36	8	..
‡Worcester	„ 15	458	— 10	„	2,328	— 137	5·75	..
Wrexham	„ 15	170	— 7	„	909	— 30	..	..
Yorks. Wool. Dist.	„ 15	1,886	+ 226	„	9,055	+ 503	17	..
Miscellaneous	„ 15	375	— 11	„	1,853	— 67	..	..
†Burnley	„ 16	1,080	+ 39	..	..	..	7·5	..
†Burton-on-Trent	„ 17	261	— 8	50	14,546	— 567	10	+ 1.5
Bury	„ 17	1,861	..	50	48,167	..	10·5	..
Cardiff	„ 16	3,815	— 3	50	102,304	+ 1,146	15·87	..
†Carlisle	„ 16	147	— 14	11	1,528	— 197	..	..
†Chatham and Dist.	„ 14	605	+ 35	11	6,307	+ 207	12·84	+ 3½
†Cork	„ 21	848	— 25	12	4,594	— 240	9·89	..
†Croydon	„ 15	1,214	+ 73	41	57,555	+ 4,005	12	+ ·75
†Darlington	„ 16	194	+ 4	50	10,403	+ 294	..	..
†Darwen	„ 15	236	+ 19	50	12,572	+ 511	4·86	..
Dover	„ 16	349	- 12	50	12,036	+ 1,059	4·75	..
†Dublin	„ 15	4,545	— 47	11	48,186	+ 76	54·25	+ ⅝
†Dundee	„ 20	2,045	+ 227	42	48,071	+ 6,716	13	+ ·1
†East Ham	„ 16	827	+ 23	50	44,341	+ 3,119	8	..
†Exeter	„ 22	495	+ 52	51	14,903	+ 614	4·75	+ ·5
†Glasgow	„ 16	16,411	+1,355	43	694,151	+56,108	86·75	+ 8¾
†Hastings	„ 22	1,577	..	..	..	..	..	..
†Huddersfield	„ 16	1,443	+ 129	50	75,026	+ 6,177	28	..
†Hull	„ 16	2,322	+ 143	50	116,394	+ 5,103	13	..
†Ilford	„ 16	414	— 10	50	23,376	+ 376	6·87	..
Ilkeston	„ 20	243	+ 18	51	6,661	+ 678	3·5	..
†Ipswich	„ 16	302	— 24	50	20,469	— 187	10·5	..
†Isle of Thanet	„ 16	250	+ 2	11	2,412	— 177	11	..
†Kilmarnock	„ 16	150	+ 8	44	6,939	+ 134	4·25	..
†Lan'kshire Trm. Co.	„ 14	1 015	+ 258	11	10,321	+ 1,423	15 8	+ 3½
†Lancashire United	„ 20	2,181	+ 586	12	11.820	+ 2,855	38·5	+ 10½
Leeds	„ 16	11,985	+ 659	48	310,981	+18,666	96	+ 6·5
†Leicester	„ 16	2,068	+ 1	..	..	..	..	..
Leith	„ 16	942	+ 80	44	22,240	+ 6,100	6	..
†Liverpool	„ 9	10,241	— 434	10	100,532	+ 990	104	..
‡L.C.C.	„ 9	55,116	+25,375	49	1,285,749	+569,747	115¼	+63
†London United	„ 22	10,896	+ 563	12	58,788	+ 2,545	..	..
†Lowestoft	„ 16	124	+ 21	24	3,151	+ 401	..	..
†Manchester	„ 16	13,109	+ 913	50	686,146	+47,765	169	+13
†Newcastle	„ 16	3,934	+ 331	50	201,704	+13,016	..	..
Newport	„ 16	1,131	+ 21	50	31,108	+ 1,935	14·5	..
†Northampton	„ 22	744	+ 26	51	21,705	+ 456	5·5	..
†Oldham	„ 17	1.768	+ 85	51	90,9 5	+ 8,104	23·75	..
†Pontypridd	„ 16	169	+ 13	50	8,292	+ 422	3·25	..
†Portsmouth	„ 16	1,430	— 38	50	94,955	+ 599	14·5	..
Preston	„ 20	1,356	+ 109	..	..	..	..	..
Reading	„ 7	1,055	— 41	49	30,463	+ 313	..	..
Rochdale	Feb. 19	958	+ 152	..	..	..	20·6	..
†Rotherham	Mar. 14	539	+ 130	50	35,131	+ 2,804	10	+ ·67
Salford	„ 18	8,362	+ 242	50	222,568	+ 6,681	38·9	..
†Sheffield	„ 17	5,332	+ 346	51	270,575	+18,822	35·75	..
†Southampton	„ 13	815	..	49	46,940	— 73	..	..
†Southend-on-Sea	„ 20	509	+ 27	51	19,083	+ 1,003	..	..
†Sunderland	„ 12	1,202	+ 23	50	69,148	+ 3,613	..	..
Swindon	„ 20	291	— 34	..	..	..	4·4	..
Tyneside	„ 20	799	+ 103	12	4,207	+ 352	8·87	..
†Walthamstow	„ 16	446	+ 77	50	27,493	+ 2,634	9	..
†West Ham	„ 14	2,087	+ 241	51	111,512	+19,294	14·7	..
Wolverhampton	„ 20	1,544	+ 89	50	42,154	+ 1,722	12·5	..
†Yorks. W. Riding	„ 17	1,005	+ 254	11	10,870	..	..	..
†Baker St.-Waterloo	„ 16	2,855	+ 592	1	2,855	+ 592	3·75	+ ·5
†Cen. London Rly.	„ 16	6,376	— 535	11	70,391	— 6,272	6	..
†City & S. Lon. Rly.	„ 24	5,690	— 289	12	36,496	+ 485	6·25	..
Dublin-Lucan Rly.	„ 22	189	— 5	12	1,039	— 16	7	..
†G.N. and City Rly.	„ 16	1,822	+ 3	11	20,814	+ 183	3·5	..
†G.N., P'dy. & Brmp.	„ 16	4,150	..	11	41,414	..	9	..
†L'pool Overh'd Rly	„ 17	1,405	+ 37	11	15.101	— 159	6·3	..
†Mersey Railway	„ 16	1,828	+ 79	11	20,147	+ 881	4·5	..
†Metropolitan Rly.	„ 17	14,715	—1,955	11	168,257	—18,535	70·5	..
†Met. District Rly.	„ 17	8,347	+ 362	11	87,659	— 1,961	24	..
†Anglo-Argentine	„ 18	17,727	+2,457	11	174,068	+11,098	43	..
§Auckland	„ 1	10,088	+ 344	7½	22,306	+ 598	19·24	+ ·6
§Brisbane	Feb.	11,000	+1,227	..	..	..	..	..
§Brit. Columbia Rly.	Jan.	24,705	+4,718	30	171,752	+28,527	..	..
Bu'n's A'r's E.T.Co.	Feb. 16	3,412	+ 532	7	11,400	+ 1,569	..	..
Bu'n's A'r's-Blgr'no	Mar. 17	7,752	+ 602	12	40,678	+ 2,666	..	..
†Calcutta	„ 23	6,025	+ 316	..	..	..	..	..
§Cape Electric T. Ld.	Nov.	14,396	..	..	..	..	..	..
§Geneva	Feb.	6.140	..	..	..	..	..	..
§Kalgoorlie, W.A.	Feb.	3,516	..	8	7,593	..	20·5	..
Madras	Mar. 15	1,122	+ 194	11	5,540	+ 497	12·75	+3·5
§Lisbon	Nov.	6,582	..	..	..	..	..	..
§Mexico	Sep.	4,400	..	..	..	..	..	..
Perth (W.A.)	Mar. 15	2,971	— 86	11	16,522	— 218	25·5	+·82

* Compared with the corresponding period of 1905. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Monday Evening.

The only people who can afford to regard the stock markets with any degree of satisfaction now are those who hold no shares of any description, and are contemplating purchases which they will be able to pay for, and, if necessary, forget about for some time. All others—unless we except those happy folk who have neither money nor investments—are the reverse of gratified with the circumstances which prices have fallen upon; markets are in a miserable state, and the general financial situation is critical.

Up to this evening, however, there has been no panic in London, beyond such as some of the halfpenny newspapers have conjured from their highly-developed powers of imagination. The gravity of the present position is underlined by the uncertainty existing as to what trouble the Stock Exchange settlement this week will disclose. To speculate upon the immediate movements of markets is to indulge in mere guess-work. Ultimately, recovery will come, but prices may possibly have to go on to lower levels first.

For electric lighting shares, the outlook at the moment does not appear brilliant. The falls which continue to occur fail to bring in buyers to any extent, though when a purchaser appears, his inquiries may have the result of putting up the price of the shares he wants to buy, in a manner out of proportion to the amount of his demand. There are a few further declines this week, as the price-lists show, and yet there are not many shares actually pressed for sale.

The unfortunate plight of the Electric Lighting market for the past few years has been that it was, and still is, overshadowed by clouds of uncertainty sufficiently dark to debar the average investor from embarking capital in the supply companies' enterprise. Confiscation of their rights, in one shape or another, sometimes modified, sometimes outrageous, has threatened shareholders for so long that money is scared away from the market. Even now, although the L.C.C. competition is removed, no additional sense of security can be claimed, and the future is regarded as a speculative proposition, as before.

The Home Railway department is suffering less than some of the others from the general slump round the markets. But it has not escaped scot free, by any means. Profound depression in the Underground group shows itself by such movements as a fresh fall in Central London Deferred to 52½, in Districts to 13½ (though Metropolitans improved to 43½), and dulness in such stocks as the Charing Cross, Euston and Hampstead Debenture. City and South London gave way a point. A drop in North London Railway stock is another reminder of the losses which electrical competition is causing the steam railways that cater for suburban traffic.

Consideration of the Anglo-Argentine Tramways dividend of 4s. per share, making 8s. for the year, has led to some disappointment being expressed that a larger distribution was not recommended. The Ordinary shares have, therefore, been rather sold, but the quotation keeps steady at 7 5/16 middle. The return to proprietors is, therefore, just about 5 per cent. on the money. There seems a likelihood that the rate may not be improved upon for some time to come, but against this possibility must be set the rumoured agreement of interests between some of the Argentine tramways, which may materialise in course of time.

National Telephone stocks are a trifle lower; this is more a matter of sympathy with the prevailing flatness than because of the result of the action with the Government in connection with private lines. Other telephone issues call for no comment.

Nor is there much feature in the Telegraph department. Anglo-American stocks have been flat in consequence of the slump which overtook American Railroad shares. The Telegraph market was also a little disturbed by sales of investments that had to be realised in order that the holders might meet losses incurred elsewhere in speculation.

Manufacturing issues are quiet, and have hardly moved during the past week.

Last Wednesday there was held the annual election in the Stock Exchange for 30 members to serve on its Committee for the ensuing year. All the existing members were re-elected, with the exception of Mr. Cecil Braithwaite, who was defeated by a dealer in the South African market.

City Meetings.—The annual meetings of the South London Electric Supply Corporation, Ltd., and the Southport Tramways Co., Ltd., were held in London on Tuesday. Our reports will appear in next week's Electrical Review.

Rand Central Electric Works, Ltd.—This company, at an extraordinary meeting held on Monday, approved the sale of the undertaking to the Victoria Falls Power Co., Ltd. The details will be given next week.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations March 19th.	Closing Quotations March 25th.	Business done week ended March 25th, 1907. Highest	Lowest.	Rise + or Fall −	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil		3 — 3½	3 — 3½	..	..	..	Nil
149 600	Do. do. 5 % Debs., Nos. 1 to 1,360 Red.	100	Nil	Nil	5 %	5 %	88 — 91	88 — 91	..	..	..	5 9 11
660,660	Anglo-American Telegraph	Stock	61s.	22½%	31½%	37½%	62 — 64	62 — 64	63½	61½	..	6 1 1
3,169,670	Do. do. do. 6 % Pref.	Stock	6 %	5½%	6 %	6 %	107 —108	106 —107	107⅝	10⅞	—1	5 12 2
3,169,670	Do. do. do. Deferred	Stock	2s.	Nil	1½%	1¾%	20½ — 20⅝	19⅝ — 19⅞	20⅝	19⅞	— ⅞	8 17 3
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	.. ..	.. ..	5 %	..	99 —101	99 —101	..	..	..	4 19 0
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	..	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	5 10 4
2,097,680	Commercial Cable Stlng. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	93 — 95	93 — 95	94⅓	94⅛	..	4 4 3
16,000	Cuba Telegraph	10	0	5 %	5 %	..	8½ — 8⅝	.. ..	..	..	..	5 14 3
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	..	16⅜ — 17⅛	16⅜ — 17⅛	..	..	..	5 14 3
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	8⅜ — 8⅝	8⅜ — 8⅝	..	..	..	5 8 6
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	9 — 9½	9 — 9½	..	..	..	5 5 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
60,7104	Direct United States Cable	20	3 %	3½%	4½%	4½%	15 — 15⅜	14⅜ — 15⅛	15	14⅜	— ¼	5 11 1
60,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	..	138 —143	137 —142	138¾	..	—1	4 18 7
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	..	86½ — 88½	86½ — 88½	..	..	..	3 19 1
1,896,766	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	..	106 —108	105 —108	106	105	— ½	3 14 1
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	..	13⅜ — 14½	13⅜ — 14½	13⅞	13⅛	— ⅛	4 19 1
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	105 —107	105 —107	..	..	..	3 14 9
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..	3 19 3
400,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
181,127	Globe Telegraph and Trust	10	5½%	5½%	5½%	..	10⅝ — 11⅛	10½ — 11	10 13/16	10⅛	— ⅛	5 0 0
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	..	14 — 14½	13⅞ — 14⅛	14⅛	13⅞	— ⅛	4 4 3
150,000	Great Northern Telegraph, of Copenhagen ..	10	15 %	44 %	24%	..	37 — 39	37 — 39	38	37	..	6 3 1
33,500	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
17,000	Indo-European Telegraph	25	10 %	13 %	13 %	..	57½ — 59½	57½ — 59½	..	..	..	5 8 10
266,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	⅝ — ¾	⅝ — ¾	17/-	16/3	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord	1	3 %	4 %	5 %	..	1 — 1⅛	1 — 1⅛	..	..	..	4 8 11
88,499	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	1 3/32 — 1 5/32	1 3/32 — 1 5/32	..	..	..	4 16 5
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	106 - 108	105 —107	106⅜	106⅛	—1	5 12 2
2,225 000	Do. do. Def. Stock	100	5 %	5 %	5 %	5½%	102 —104	102 —104	103	101	..	5 5 9
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	11 — 13	11 — 13	..	..	..	4 12 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10 — 12	10 — 12	..	..	..	4 8 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	5 1/16	5⅛	..	4 8 11
4,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	97 — 99	96½ — 98½	97	96½	— ½	3 11 1
1,689,598	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100 —102	100 —102	101⅛	..	..	3 18 5
179,318	Oriental Telep. and Elec. 1 to 171,604, fully paid	1	6½%	6½%	7½%	..	1 5/16 — 1 7/16	1 5/16 — 1 7/16	27/6	..	..	5 4 4
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	..	1⅛ — 1¼	1⅛ — 1¼	..	..	..	4 16 0
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	4 %	4 %	96½ — 98½	95 — 98	96	..	—1	4 1 8
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
11,8394	Reuter's	8	6 %	5 %	5 %	..	7½ — 8	7⅞ — 8	..	..	..	5 0 0
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	4 %	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
3,167	Submarine Cables Trust	Certs.	6 %	6 %	6 %	6 %	126 —129	126 —129	126½	..	..	4 13 0
80,000	United River Plate Telephone	5	5 %	5 %	5 %	..	6⅜ — 7⅛	6⅜ — 7⅛	6¾	..	..	5 10 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	..	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	4 11 11
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	109 —112	109 —112	..	..	..	4 9 3
15,6094	West African Telegraph, Shares	10	4 %	4½%	4 %	..	10 — 10½	10 — 10½	..	..	..	3 16 2
80,008	W. Coast of America, 1 to 80,000 & 58,001 to 58,008	2½	Nil	Nil	Nil	..	⅜ — ⅝	⅜ — ⅝	..	..	..	Nil
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980 ..	10	7 %	7 %	7 %	..	13¾ — 14¼	13¾ — 14	13 15/16	13½	— ¼	5 0 0
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	101 —104	101 —104	101	..	..	3 16 11
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	2 — 2 11/16	2 — 2 11/16	11/6	..	..	Nil
34,568	Do. do. 6 % Cum. 1st Pref.	10	7 %*	6 %	5 %	..	7 — 7⅝	7⅛ — 7⅝	..	..	+ ¼	6 9 0
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	5¾ — 6¼	5¾ — 6¼	..	..	..	Nil
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	99 —102	99 —102	..	..	..	4 18 0

Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,008 to 580,007		..	8 %	8 %	8 %	7⅞ — 8⅛	7 15/16 — 8 1/16	7 31/32	7⅞	— 1/16	4 19 3
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	5½%	5½%	5½%	5½%	6⅞ — 6¾	5 13/16 — 6 1/16	5¾	..	— 1/16	4 10 9
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	132 — 135	132 —135	..	..	..	4 8 11
385,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	104 —107	104 —107	104	..	..	4 13 6
830,000	Babcock & Wilcox, 1 to 830,000	1	17 %	30 %	20 %	..	3⅞ — 4⅛	3⅞ — 4⅛	80/3	80/-	..	4 14 0
400,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	..	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..	3 15 7
88,000	British Aluminium, Ord., 2,001 to 40,000	5	..	7 %	7 %	..	5¼ — 5⅜	5¼ — 5⅜	..	..	..	6 1 9
40,000	Do. do. 7 % Cum. Pref..	5	Nil	7 %	7 %	..	5⅞ — 6¼	5⅞ — 6¼	..	..	..	5 12 0
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	..	5¼ — 5⅜	5¼ — 5⅜	..	..	..	5 4 4
20,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	..	4 — 4¼	4 — 4¼	..	..	..	4 8 11
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	..	101 —105	101 —105	..	..	..	4 15 3
800,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	5½%	98 —101	98 —101	99⅛	..	..	5 8 11
400,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	6 %	..	127 —131	126 —130	129	128⅝	—1	4 12 4
400,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	..	109 —113	109 —113	..	..	..	4 8 6
300,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	104 —108	103 —107	..	..	—1	4 13 6
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	100 —102	100 —102	101⅜	..	..	4 8 3
450,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	102⅛—104½	102⅛—104½	..	..	..	4 6 2
188,801	British Electric Traction	10	6 %	6 %	3 %	..	3⅜ — 3⅝	3⅜ — 3⅝	..	..	..	7 14 10
161,489	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	..	7⅛ — 7⅜	7 — 7⅜	7⅛	7 1/16	— ⅛	8 0 0
1,448,653	Do do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	106 —109	103 —108	..	..	—2½	4 12 7
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	..	83 — 86	83 — 86	83	..	..	5 4 8
100,000	British Insulated and Helsby Cables	5	5 %	5 %	5 %	10 %	7¼ — 7⅜	7¼ — 7⅜	..	..	..	6 9 0
100,000	Do. do. 6 % Cum. Pref.	5	5 %	6 %	6 %	6 %	5¾ — 6¼	5¾ — 6¼	..	..	..	4 16 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	..	92 — 96	92 — 96	..	..	..	4 13 9
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	..	1 — 1½	1 — 1½	..	..	..	Nil
1,016,858	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	67 — 71	67 — 71	..	..	..	5 12 8
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	⅝— ¾	⅝— ¾	..	..	..	Nil
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	4½%	..	⅝— ¾	⅝— ¾	..	..	..	5 14 3
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	..	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	6 8 0
125,000£	Do. 4½ % Perp. Deb. Stock	Stock	4½%	4½%	4½%	4½%	88 — 92	89 — 92	..	..	..	4 17 10
125,000£	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	75 — 78	75 — 78	..	..	..	5 15 5
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	3 %	4 %	3 %	..	3⅛ — 3⅜	3⅛ — 3⅜	71/10	66/3	..	4 0 0
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	..	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	5 11 8
27,500	Do "B" do. 1 to 27,500	5	6 %	6 %	6 %	..	5 — 5⅛	5 — 5⅛	..	..	..	5 14 3
13,200	Do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	104 —106	104 —106	..	..	..	4 14 4
190,000	Do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	101 —104	101 —104	..	..	..	4 16 2
105,000	Calcutta Trams., 1 to 105,000	5	6 %	8 %	8 %	..	8½ — 8⅝	8¼ — 8⅝	8 5/16	..	..	4 11 5
82,610	Do. 105,001 to 187,610	5	..	..	8 %	..	7⅛ — 8⅛	7⅞ — 8⅛	..	..	..	4 15 6
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,330	5	..	..	5 %	5 %	5¼ — 5⅜	5⅜ — 5⅝	..	..	..	4 6 11
350,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	105 —108	105 —108	106⅛	106	..	4 3 4
35,000	Callender's Cable Construction shares	5	(24½%	(24½%	15%	..	9¾ — 10⅜	9⅝ — 10⅜	10⅛	..	..	6 19 6
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	5¾ — 5⅞	5⅝ — 5⅞	5⅞	..	..	4 6 11
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	106 —108	106 — 108	..	..	..	4 3 4
491,222	Cape E. Trams., 1 to 491,222	1	10 %	5 %	Nil	..	1/16 — 1/8	1/16 — 1/8	10/3	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %		1 1/16 — 1 1/8	1 1/16 — 1 1/8	25/-	24/6	..	4 11 5
224,988	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%		97 —102	97 —102	..	..	..	4 8 3
911,568	Central London Railway, Ord. Stock .. .	Stock	4 %	4 %	4 %	4 %	69 — 71	69 — 71	69	..	..	5 12 8
544,216	Do. do. 4 % Pref. Stock .. .	Stock	4 %	4 %	4 %	4 %	92 — 94	92 — 94	..	..	..	4 5 1
544,216	Do. do. Def. do. .. .	Stock	4 %	4 %	4 %	4 %	53 — 56	51 — 54	51	..	— 2	7 8 2
1,480,000	City and South London Railway	Stock	2⅝	2½	1⅝	2½	40 — 42	38 — 40	41⅛	41⅛	—2	5 6 3
85,000	Crompton & Co., Nos. 1 to 85,000	8	2½%	2½%	2½%	..	2 1/16 — 2 5/16	1⅞ — 2⅛	..	..	— 1/16	3 10 2
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	96 99	96 — 99	..	..	..	5 1 0

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated, all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued.)*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Mar. 19th.	Closing Quotations Mar. 25th.	Business done week ended Mar. 25th, 1907. Highest	Lowest.	Rise + or Fall—	Present Yield per cent. £ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	† 1	..	10 %	10 %	..	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	6 3 1
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	..	1½ — 1¾	1⅝ — 1¾	..	..	..	4 16 0
294,150	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
60,000	Dublin United Trams. (1896), 1 to 60,000	10	5⅝%	6 %	6 %	..	13⅜ — 14⅜	14⅛ — 15⅛	..	..	+ ⅛	3 18 8
59,987	Do. 6% Pref. between 1 and 60,000	10	6 %	6 %	6 %	..	13⅜ — 14⅜	14⅛ — 15⅛	..	..	+ ⅛	3 18 8
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	2½%	4½%	..	1⅜ — 1⅝	1⅜ — 1⅝	25/6	..	..	9 3 9
17,189	Do. "A" shares, 01—017,189	5	Nil	2½%	4½%	..	2¼ — 2⅜	2⅛ — 2⅜	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..	4 12 0
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..	5 5 3
112,100	Electric Construction 1 to 112,100	† 2	4 %	Nil	Nil	..	1 — 1 7/16	1 — 1 7/16	..	..	..	Nil
81,390	Do. do. 7 % Cum. Pref., 1 to 81,390	† 2	7 %	7 %	7 %	..	1⅝ — 2	1⅝ — 2	..	..	..	7 0 0
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	81 — 84	81 — 84	..	..	..	4 15 8
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	8⅞ — 9⅛	8⅞ — 9⅛	..	..	..	5 2 4
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	94 — 97	94 — 97	..	..	..	4 2 6
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	3 %	4 %	4 %	4 %	3⅛ — 3⅜	2⅞ — 3⅛	..	..	— ⅛	12 6 2
66,000	Greenwood & Batley 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10¼ — 10½	10¼ — 10½	..	..	..	6 13 4
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	102 —103	..	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	15 %	12 — 13 xd	12 — 13	12⅝	12	..	5 15 5
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5⅛ — 5⅝	5¼ — 5⅝	..	..	..	4 2 7
150,000	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	107 —109	107 —109	..	..	..	4 2 7
60,000	India-Rubber, Gutta-Percha & Telegraph Works..	10	10%	5 %	10%	10 %	15½ — 16½	15½ — 16½	..	..	..	6 3 1
37,500	†Liverpool Overhead Railway, Ord.	10	1⅜	1⅜	Nil	Nil	1½ — 1⅝	1½ — 1⅝	..	..	..	Nil
10,000	† Do. do. £10 paid	10	5 %	5 %	5 %	5 %	6 — 7	5⅝ — 6⅝	..	..	— ⅛	7 8 2
600,070	London United Trams (1901), 1 to 50,007	10	8 %	6 %	3 %	3 %	7 — 8	7 — 8	..	..	..	3 15 6
899,930	Do. do. 60,008 to 100,000 (£8 paid)	10	8 %	6 %	3 %	3 %	5 — 5⅛	5 — 5⅛	..	..	..	5 2 2
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	7⅞ — 8⅛	7⅞ — 8⅛	8⅛	..	..	5 14 3
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	85 — 90	85 — 90	87½	..	..	4 8 11
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	Nil	1/16 — 3/16	1/16 — 3/16	2/3	..	..	Nil
600,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	11/16 — 13/16	11/16 — 13/16	17/-	16/3	..	5 6 8
850,000	Do. 4½ % Deb. Stock Red.	100	..	4½%	4½%	4½%	96 — 99	96 — 99	99	97½	..	4 10 11
80,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 50,000	5	..	6 %	6 %	6 %	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..	6 10 8
125,000	Potteries E. Trc.	1	5 %	5 %	4 %	..	3/16 — 5/16	3/16 — 5/16	13/6	..	..	5 6 8
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	5/16 — 7/16	5/16 — 7/16	..	..	..	6 3 1
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	..	99½—101¾	99½—101¾	..	..	..	4 8 8
87,350	Telegraph Construction and Maintenance	12	20 %	15 %	15 %	15 %	30½ — 32½	30 — 32	31	30	— ½	5 12 2
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
699,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	5 %	5 %	5 %	83 — 85	83 — 85	..	..	..	5 17 8
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	† 5	3 %	Nil	Nil	..	1½ — 1⅝	1½ — 1⅝	..	..	..	Nil
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	† 5	6 %	Nil	Nil	..	3½ — 3⅝	3½ — 3⅝	70/-	65/-	..	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	77 — 82	77 — 82	..	..	..	4 17 7

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	5 %	5⅛%	5⅛%	..	5 — 5⅛	5 — 5⅛	..	..	..	5 0 0
71,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 0
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 30,000	5	10 %	10 %	10 %	10%	7⅛ — 8⅛ xd	7⅛ — 8⅛	7½	..	— ⅛	6 1 3
10,502	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7 — 8 xd	7 — 8	..	..	..	4 7 6
336,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
80,000	Charing Cross and Strand Electricity Supply	5	8 %	8 %	5 %	5 %	3 — 4 xd	2⅞ — 3⅛	63/4½	62/6	— ⅛	6 13 4
80,000	Do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4 — 4½	4 — 4½	..	..	..	5 0 0
80,000	Do. "City Undertaking" 4½ % Cum. Pri.	5	4½%	4½%	4½%	4½%	3⅞ — 4⅛	4 — 4⅛	..	..	+ ⅛	5 0 0
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	6 —99	96 — 99	96⅜	..	..	4 0 10
49,436	Chelsea Electricity Supply, Ord.	5	5½	6	6	6%	3⅜ — 4⅛	3⅜ — 4⅛	78/9	..	..	5 5 11
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	104 —107	104 —107	..	..	..	4 4 1
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	6 %	9½ — 10⅜ xd	9½ — 10¼	9⅝	..	..	5 17 1
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11⅛ — 12⅜ xd	11 — 12	..	..	— ⅛	5 0 0
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 116) all pd.	..	5 %	5 %	5 %	5 %	121 —124	121 —124	..	..	..	4 0 8
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	97 —100	97 —100	98½	..	..	4 10 0
40,000	County of Durham Electrical Power, Ord.	4	4 %	£8 7 0	4 %	4 %	3⅛ — 4 3/16	3½ — 4	..	..	— 5/16	4 0 0
50,000	Do. do. do. 6 % Pref.	5	5 %	5 %	5 %	5 %	4⅜ — 5⅛	4⅜ — 5	..	..	— ¼	5 0 0
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4½%	5 %	5 %	7⅛ — 8⅜ xd	7⅛ — 8⅛	..	..	..	5 17 8
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10 — 11 xd	10 — 11	10⅜	10 5/16	..	5 9 1
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	105 —108	105 —108	107¼	..	..	4 3 4
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	97 —100	97 —100	..	..	..	4 10 0
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	4 %	..	2⅛ — 2 5/16	1⅝ — 2⅛	..	..	— 5/16	8 0 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	..	3⅜ — 4	3⅜ — 4	..	..	..	7 10 0
350,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	88 — 91	88 — 91	..	..	..	4 18 11
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	5⅛ — 5⅝	5⅛ — 5⅝	..	..	..	4 17 9
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 15 3
90,000	Do. 4½ % 1st. Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100	97 —100	..	..	..	4 10 0
18,000	Hove, 1 to 18,000	5	8½%	8½%	9 %	9 %	7⅛ — 7⅜	7⅛ — 7⅜	..	..	..	5 16 2
21,000	Kensington and Knightsbridge Electric Ord.	5	12½%	12 %	10 %	10 %	8⅞ — 9⅛ xd	8⅞ — 9⅛	..	..	..	5 0 0
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3	4 %	4 %	1⅜ — 2¼	1⅜ — 2¼	..	..	..	5 6 8
70,000	Do. do. do. 5 % Pref...	5	6 %	6 %	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	5 14 3
574,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	95 — 98	95 — 98	..	..	..	4 11 10
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8½%	10 %	10 %	8 %	6 — 7 xd	5⅜ — 6⅜	..	..	— ⅛	5 18 6
76,121	Do. do. 5 % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅞ — 5⅛	4⅞ — 5⅛	..	..	..	4 8 9
220,000‡	Do. do. 4½ % 1st Mort. Debens. Stock	..	4½%	4½%	4½%	4½%	106 —110	106 —110	..	..	..	4 1 10
250,000‡	Do. do. 3½ % Mort. Deben. Stock Redeem.	Stock	3½%	3½%	3½%	3½%	90 — 93	90 — 93	..	..	..	3 15 3
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
67,991	Newcastle-on-Tyne	5	8 %	8 %	8 %	8 %	7⅛ — 8	7⅛ — 8	..	..	..	5 0 0
75,000	Do. 5 % Pref., 1 to 75,000	5	5%	5 %	5 %	5 %	5⅜ — 6⅛	5⅜ — 6⅛	..	..	..	4 0 0
10,852	Notting Hill Electric Lighting	10	6 %	7 %	7½%	7½%	12 — 13	12 — 13	12½	12⅝	..	5 15 5
64,000	Do. do. 4 % 1st Mort.Deb...	100	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6½%	7 %	7 %	7 %	5⅝ — 6⅛ xd	5⅜ — 6¼	..	..	+ ⅛	5 12 0
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	96 — 98	96 — 98	..	..	..	4 1 8
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	12½%	10 %	7⅛ — 8⅛	7⅛ — 8⅛	8⅛	..	..	5 17 8
20,000	Do. do. 7 % Pref. 20,001 to 40,000	5	7 %	7 %	7 %	7 %	6⅞ — 7⅜	6⅞ — 7⅜	6⅞	..	..	4 13 4
150,000‡	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	93 — 95	93 — 95	..	..	..	3 13 8
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	Nil	1⅛ — 2⅛	1⅛ — 2⅛	..	..	..	Nil
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	72 — 76	72 — 76	..	..	..	5 5 3
65,000	South London Electricity Supply, Ord.	5	8 %	4 %	4 %	3 %	2⅜ — 3	2⅜ — 3	..	..	..	6 13 4
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	2½%	2½%	5/8 — 3/4	5/8 — 3/4	..	..	..	3 6 8
117,368	Do. Do. 7 % Pref...	1	7 %	7 %	7 %	7 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	5 1 10
200 000	Do. Do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
80,000	Urban Electric Supply, Ord.	5	6 %	6 %	5 %	..	2⅛ — 3⅛	2⅛ — 3⅛	..	..	..	7 13 10
50,000	Do. do. 5 % Cum. Pref.	5	6 %	6 %	5 %	..	3⅜ — 4¼	3⅜ — 4¼	..	..	..	5 17 8
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	4½%	4½%	..	99 —102	99 —102	..	..	..	4 8 3
110,000	Westminster Electric Supply, Ord.	5	13½%	14 %	13 %	12 %	9½ — 10⅛	9 — 10	9⅝	..	— ¼	6 0 0
81,279	Do do. 4½ % Cum. Pref. (Originally 5%—Red. to 4½ % from 31st Dec., 1906.	5	5 %	5 %	5 %	4½%	5⅛ — 5⅜	5⅛ — 5⅜	5⅜	..	..	3 18 3

Shares not officially quoted:—Mackay Companies, ord., 68—71 — 1½. Pref. 68—71 — 1½.
† Unless otherwise stated all shares are fully paid. ‡ Interim dividends.

Bank rate of discount 5 per cent. January 17th, 1907.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING FEBRUARY, 1907.

ALTHOUGH somewhat lower, in all three sections, than in the preceding month, the February returns of electrical business still attain to very satisfactory figures, judged by last year's trade.

The exports for the month of February totalled some £144,571, as compared with £150,251 in the previous month, a decrease of £6,000; the imports similarly, at £146,834, show a decline of £7,500 in value; and the re-exports at £13,215 are some £3,000 below the January total.

Instructive comparisons may be made with the same month of last year and with the last year's average; thus as regards the exports, they are fully £28,000 to the good in the former case, and £10,000 in the latter; the imports on the other hand are much below the exceptionally high total, viz., £170,109 recorded in February, 1906, and are slightly below the 1906 average.

The re-exports are somewhat above both the month's and the year's average figures.

The one exceptional item of exports during the month is "cable," which attained the high total of £50,000; in the import section, the telephone imports are unusually low, standing at £17,000 approximately as compared with some £30,000 in January.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.*

Country receiving exports and importing.	Electrical goods and appliances.	Electrical cable.	Electric lighting fittings and accessories.	Electric lamps.	Electric meters and instruments.	Electric machinery.	Batteries and accumulators.	Carbons.	Telegraph and telephone material, and electric bells.	Electrically-driven machinery	Tramways apparatus and materials.
	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark	199	3,297	26	52	...	600	6	...	27	...	...
Germany	142	1,033	17	60	166	1,343	...	...	30	15	...
Netherlands...	162	1,015	221	...	...	145	...	...	4	...	...
Dutch Borneo, Java and Dutch Ind. Possessions	64	...	...	4	...	...	...	...	...	...	...
Belgium	51	71	38	2	160	145	...	15	669	50	...
France	38	...	7	150	...	464	...	...	...	...	...
French Indo-China...	20	...	...	12	...	...	...	...	...	...	...
Portugal, Madeira and Portuguese Africa ...	69	262	82	425	265	358	...	18	121	74	...
Spain	465	...	405	...	...	249	6	...	...	1,000	...
Italy, Austria-Hungary and Bulgaria	204	...	11	273	...	136	...	...	...	...	...
Egypt and Tunis	128	455	241	43	319	369	205	34	914	1,027	...
China and Siam	928	1,615	404	167	27	1,311	21	189	...	...	...
Japan	487	7,545	...	...	1,858	7,679	...	...	...	540	...
U.S.A. and Cuba	711	...	...	311	8	186	...	...	...	...	...
Mexico, Colombia, Peru and Uruguay	204	165	...	285	5	1,092	23	...	18	222	...
Chili	887	577	...	65	45	90	18	...	1,069	...	...
Brazil	2,204	3,518	26	70	...	6,187	220	...	76	48	...
Argentine	5,625	4,448	1,316	322	...	3,740	715	...	...	...	...
Channel Isles, Gibraltar and Malta	273	791	74	44	53	28	7	3	22	270	...
British West Africa	75	56	2	...	37	38	...	8	...	...	...
Cape of Good Hope	2,071	2,680	429	247	28	1,262	36	11	32	1,210	...
Natal...	1,147	641	366	351	126	736	92	76	2	6	...
Brit. East Afrina, Mauritus and Aden	6	25	3	...	...	...	2	7	51	...	...
India...	2,280	13,823	1,319	431	752	4,750	640	136	54	2,079	24
Burmah	62	41	325	239	107	895	11	...	...	...	...
Ceylon	87	...	18	2	...	...	38	...	21	51	...
Straits Settlements...	567	419	474	166	...	54	245	...	...	56	...
Hong Kong	58	2,051	25	146	48	80	134	2	86	...	...
West Australia	1,660	46	74	152	142	313	11	...	...	...	...
South Australia	261	646	66	...	...	553	...	...	...	...	...
Victoria	564	2,466	218	...	156	1,221	3	...	99	9	...
New South Wales	1,769	2,817	492	754	101	984	320	10	1,619	108	...
Queensland	97	...	95	...	...	209	5	...	...	...	...
Tasmania	...	...	3	...	...	22	5	...	...	...	...
New Zealand	221	...	246	33	55	2,409	10	...	34	491	...
Canada	212	177	162	...	...	31	...	39	24	...	...
British West Indies, British Guiana, and Bermudas	77	...	26	12	73	4	...	...	...	...	...
Total, £	24,075	50,680	7,211	4,818	4,531	37,683	2,773	548	4,972	7,256	24

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

	£	£	£	£	£	£	£	£	£	£	£
Russia, Norway, Sweden and Denmark	73	214	...	106	...	2,310	232	...	6,406	...	...
Germany	2,444	27,888	602	1,799	95	9,422	428	977	1,531	40	...
Holland	426	4,385	2,822	8,728	...	5,591	189	4,099	256	...	...
Belgium	1,001	3,843	449	4,925	129	3,146	51	2,287	9,038	...	...
France	409	5,531	2,493	1,009	607	3,638	809	3,719	...	...	...
United States	1,680	940	302	92	155	17,484	182	763	72	893	...
Total, £	6,033	42,801	6,668	16,659	986	41,591	1,891	11,845	17,303	933	...

Additional Imports: Austria-Hungary, carbons, £233. Canada, deduct machinery £109, to correct January account.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

	£	£	£	£	£	£	£	£	£	£	£
Various countries, mainly as above	2,942	1,837	236	172	20	3,060	...	58	4,800	90	...

TOTAL EXPORTS: £144,571

TOTAL RE-EXPORTS: £13,215

TOTAL IMPORTS: £146,834

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

* This section does not include telegraph cables and apparatus.

REVIEWS.

The Principles of Electric Wave Telegraphy. By J. A. Fleming, M.A., D.Sc., F.R.S. London: Longmans, Green & Co. 1906. Price 24s.

The scope of this work is amply indicated by the title, as its value also is by the name of the author; the name of Dr. Fleming is a guarantee of excellence, not merely because of his scientific attainments, but also because of his close practical touch with the engineering side of the matter. The aim of the present volume is stated to be not so much descriptive as educational, and it therefore deals chiefly with the scientific principles underlying the art and the appliances connected therewith, especially from the point of view of accurate quantitative measurement of the various effects concerned. This avowal is somewhat disappointing to many who could have wished for a practical as well as theoretical exposition of the subject from Dr. Fleming. We must, however, be thankful for small mercies, and trust that the present volume may be supplemented in this direction when the calls on Dr. Fleming's time and the exigencies of commercial competition permit.

The present work is based to a large extent on the numerous scientific dissertations and well-known Cantor Lectures which Dr. Fleming has delivered from time to time. These have, however, been greatly amplified and supplemented. The book is divided into three parts, dealing respectively with Electric Oscillations, Electric Waves, and Electric Wave Telegraphy, The latter title, and, indeed, the title of the work itself are perhaps not very happy ones, inasmuch as "electric wave telegraphy" is hardly distinctive. All electric telegraphy is entitled to this description.

Chapter I deals with the production of high-frequency currents and electric oscillations. In this connection the arrangement for producing high-frequency oscillations from an alternating-current supply with the aid of a high-tension transformer is outlined. The explanation given of the function of the choking coils inserted between the spark gap and the secondary winding of the transformer does not appear to be a complete one. They are called "arc quenching inductances," and are said to be used for the prevention of "arcing" between the spark balls. This end can be attained in other ways, but the coils have generally a more important function to fill, which is to choke back the condenser oscillations from the secondary windings of the transformer, as otherwise damage would almost certainly result from repeated perforation of the insulation of the windings. This object may be more completely and easily attained by also adding a small suitable condenser across the terminals of the transformer. The windings of the transformers used may themselves be so arranged and insulated as to perform this very necessary function, but they are not usually so designed. Incidentally, also, there are two other useful attributes of the choking coils. By virtue of their choking effect the damping of the oscillations themselves, due to the connection of the transformer to the condenser circuit, is often diminished, and the length of train in each oscillation consequently enhanced. Nor is it with high-tension transformers only that choking coils should be used. They are often a very necessary safeguard where ordinary spark coils are concerned, as the very numerous instances of such coils breaking down with even quite moderate power, in the absence of proper provision of this kind, will testify. There is no reason why a spark coil or transformer properly protected against such "back surges" should be more liable to strains in wireless telegraphy than in X-ray applications, if so much. The E.M.F. developed in the secondary winding is usually much greater in X-ray work than in wireless telegraphy. Nor is this the only damage caused by these surgings in wireless telegraph installations. Any windings on apparatus used in connection with the transmitter, such as those on small motor-driven interrupters, are liable to be affected. The readiest means of affording protection in cases of this kind is to use shunting condensers of one or two microfarads capacity, unless it is considered worth while to use metal-sheathed connecting wires. Numerous other cases where this safeguard is desirable will readily present themselves. The other useful attribute of the choking coils referred to above lies in the facility with which they lend themselves to making the secondary circuit of the transformer and high-tension condensers resonant with the periodicity of the applied alternating current.

In this chapter the design and theory of the induction coil receive considerable attention, and it is pointed out that for purposes of wireless telegraphy the resistance of the secondary winding is an important consideration. Great stress is laid on the advisability of keeping the resistance as low as possible, other things being, presumably, equal. The statement is carefully qualified by indicating that a limitation exists from the necessity of keeping the size of the coil reasonable. It might be assumed that the author considers that too thick a wire is always used in the design of these instruments. There are, however, two sides to this question, and experience shows that one cannot reduce the inductance of the secondary winding of a spark coil of standard design with impunity. Any attempt in this direction will almost certainly result in most erratic and unsatisfactory sparking. The reason for this behaviour is not far to seek, and Dr. Fleming comes near to the explanation in a footnote on page 37, in which he refers to a surmise that the oscillations of the condenser in the primary circuit may have some effect in assisting the demagnetisation of the core. The ratio of primary and secondary inductance cannot be decreased with impunity, as it is necessary for the proper working of a coil that these condenser oscillations be not reproduced inductively in the secondary winding as would be the case if its inductance were not sufficient to choke them out. The last word on the theory of the induction coil has not yet been said. A great deal of information from the work of various experimenters relative to this matter is given, and there is much room to collate and bring into harmony the different results obtained. It is, perhaps, worth pointing out that most of the different investigations with reference to such matters as *optimum* capacity, the resistance and inductance of windings, &c., can, however, be reconciled by a proper appreciation of the above important function of the condenser. There is no doubt that it serves the important purpose of extinguishing or minimising the arc at the contact points, but the additional function referred to above is not generally appreciated. The action of the condenser oscillations in this case is, of course, entirely analogous to the action of the magnetic detector. The effect produced on the iron by powerful oscillations is extremely strong, as can be shown by connecting such a detector to the stay wires of a wireless telegraph installation at work. In such experiments as those of Lord Rayleigh, in which the primary circuit is broken by the agency of a rifle shot, the use of a condenser is unnecessary. In this case sufficiently powerful oscillations doubtless take place from end to end of the primary winding to give the desired effect on the core.

At the end of Chapter II, which deals with high-frequency electric measurements, Dr. Fleming describes in detail his spark counter. The primary idea involved is the same as that made use of by Messrs. Duddell and Taylor in the measurements which formed the subject of an Institution paper, but which was only referred to in the earlier proofs. The sparks are counted by causing them to perforate a moving band of paper. Dr. Fleming has added appliances for accurately timing the duration of contact. For most purposes, however, such appliances can be dispensed with, as in practice it will generally be found sufficient to depress the signalling key for a stated interval of time, and then count the perforations made.

Chapter III deals with questions of damping and resonance, and provides an admirable summary of the best work that has been done in this direction. This concludes Part I. The opening chapter of Part II deals with the so-called stationary electric waves on wires; a subject which would, perhaps, be more properly included in the first section under electric oscillations, for "stationary waves" are oscillations, and there does not appear to be any valid reason why this term should not be adhered to, reserving the term "waves" to denote travelling impulses. The adoption of this nomenclature would avoid the use of such inconsistent

expressions as "the propagation of stationary waves," of which a certain eminent scientist has been guilty. Of course, stationary waves (*i.e.*, oscillations) are not formed until the propagation has been effected and completed. At the close of the chapter, the interesting case of transmission from closed or loop-circuit aerials is investigated, in which the theory is advanced that harmonic vibrations are set up which are responsible for the radiation. There are certain experiments which tend to throw some doubt on this view, and the matter will, perhaps, bear further investigation.

Chapter V forms specially interesting reading; the reasons for the assumption of an all-pervading ether (or "aether" as Dr. Fleming appears to prefer it) and the orthodox speculations as to its nature are well summed up. In paragraph 4 appears a statement which apparently is not strictly accurate. The characteristic of a true wave is said to be that in each portion of the medium the energy being conveyed exists alternately as energy of strain and energy of motion or their equivalents. Since, in a true wave propagation, the energy is always half kinetic and half potential, the two being in phase with one another, it is surely evident that the energy being conveyed does not oscillate between the two types as stated.

The physical conception of electric wave formation deduced from considerations of the changing distribution of the electric field during discharge receives prominent attention. The treatment accorded is, however, superficial, and, without being hypercritical, exception may be taken to some of the statements. One would be led to suppose, for instance, that the formation of the closed loops of strain referred to is the sole cause of wave propagation. In view of the fact that such closed loops are produced under many circumstances in which appreciable radiation is out of the question, this can hardly be the whole truth of the matter; moreover, though waves do travel out as closed loops of strain from a linear Hertzian oscillator, the waves do not represent the original loops translated bodily from the field of the oscillator. There is a little more in the question than this, as a considerable part of the energy associated with the loops in the neighbourhood of the oscillator of necessity falls back into the system at each semi-oscillation. A somewhat crude reference is also made to the loops which are formed being pushed outwards by the birth of new ones. It occurs to one to ask what pushes out the last loop which forms the termination to a train of waves. In this section it is perhaps hardly made sufficiently clear that the electric and magnetic fields are simply an indication we have of the existence of wave disturbance in the ether rather than an additional effect superposed. Full diagrams illustrating the changes in the electric field about an oscillating system, according to Prof. K. Pearson, Prof. Love, and Dr. Hack, are reproduced, but the original Hertz diagrams are absent. Pearson's diagrams are intended to show the departure from the Hertz when considerations of damping are introduced. These matters have apparently been investigated by complex mathematical methods only up to the present time, but there does not appear to be much reason why they could not be dealt with on general lines from the point of view of optical theory.

Although it is stated in the preface that the present treatise is based to a large extent on Cantor Lectures, it is pleasant to observe that Dr. Fleming is not insisting so much on dragging electrons into the theory. Some remnants yet remain, however. It is hard to see that electronic considerations render any assistance in elucidating the theory of wireless telegraphy. It is a severe stretch to the imagination to be asked to conceive that electrons dash up and down a radiating antenna with a velocity which must greatly transcend the speed of light.

The next chapter is largely devoted to historical matters and to eulogies of Marconi, explicit or implied. One small matter in connection with the earliest forms of wireless telegraph apparatus may be worthy of reference. Dr. Fleming gives on page 364 an explanation of the function of the choking coils attached to the terminals of the coherer in Marconi's early form of receiver, which is somewhat doubtful. It is stated that the choking coils were intended to prevent the coherer from being affected by the small sparks produced at the contacts of the relay, tapper, &c. In view of the fact that all contacts or coils, or both, were carefully shunted by non-inductive resistances, a more probable explanation is that the *intention* was to prevent the received oscillations from being shunted round the relay circuit, *viâ* the non-inductive resistances. In fact, this is the explanation given a little further on (page 426). The actual explanation, however, of the undoubted benefit these choking coils conferred when adjusted to an approximately correct size (and on this point Marconi was very particular) is very different to either of the foregoing. There can be very little doubt that it lay in the fact that an inductive path to earth was provided for the received oscillations through the choking coils. The coherer thus became an *overflow* to the inductive choking coils, and the device therefore anticipated in some degree later developments of tuned systems, though unwittingly. There is, perhaps, hardly sufficient stress laid on the fact that the early method of inserting a detector of the disconnection type, such as the filings coherer, between the antenna and earth is all but a fatal mistake, because it interrupts the very receiving system in which it is essential that oscillations should be built up by the cumulative action of waves sufficiently nearly in tune. Ever since the very earliest days Marconi has insisted on the benefits of tuning, and there was much more syntony even in the crude system originally devised by him than many are inclined to admit is possible with "whipcrack" impulses.

An important point dealing with the question of "coupling" occurs on page 411 and elsewhere. The coefficient of coupling is defined as $\frac{M}{\sqrt{L\,N}}$, which being translated means, as referring to inductive coupling, that it is the ratio which the mutual inductance bears to the geometric mean of the inductance of the primary and secondary windings of the *oscillation transformer*. The coupling is said to be tight when this ratio exceeds 0·5 and loose when smaller. It is not clear that this is a correct definition, because it does not include the inductance of the antenna itself, nor any inductance inserted in series with, but entirely extraneous to, the oscillation transformer. Yet a strong coupling can be made into a weak one by the addition of extraneous inductance, either in the antenna or in the primary circuit; the alteration in the time period being compensated for by corresponding changes in the capacity in each circuit. From this point of view it is doubtful whether Marconi's earlier methods of syntonic telegraphy were as closely coupled as Dr. Fleming appears to imagine. Indeed, the very fact of being able to *properly* dissociate waves of different frequency on a single antenna, as Marconi did at a very early stage, seems to indicate moderately weak coupling and consequent sharp tuning.

In connection with the earliest wireless telegraph patents, it is of some interest to note that Marconi's first application for a patent in Great Britain was filed in March, 1896, but was abandoned, probably on expert advice, being replaced by the patent which has drawn so much scientific criticism. The date at which Marconi brought his apparatus to the Post Office is generally stated to have been in July, 1896, but, as a matter of fact, it was a little earlier than this.

There is a little matter on page 561 which, though of no great importance, would seem worth while clearing up. In connection with the relation between wave lengths and length of wire forming the radiating system, it is pointed out that a considerable error may be made by including the length of any part of the wire which may be coiled up in the form of a spiral, Duddell and Taylor being quoted as the "horrible example." If pages 341 and 342 of the Institution *Journal*, Vol. 35, be referred to, it will be found that the authors are equally explicit on this particular point. Indeed, it is mainly for this reason that the approximate wave lengths given are all on the high side of four times the total length of wire, and it is almost entirely for the same reason that no wave lengths are given in respect of the more important tests described in the Appendix to the paper in question. In quoting from this paper, it is somewhat strange that Dr. Fleming has omitted any reference to the Appendix mentioned, although, from the point of view of quantitative measurement, the experiments described therein are by far more conclusive and convincing than those which are reproduced in this book.

On pages 624 *et seq.*, recent developments concerning directed wireless telegraphy are treated of. It is, however, not explained whether the use of the particular shape of antennæ necessary, on Marconi's plan, to give semi-directional radiation, results, as might be expected from theoretical considerations, in a less efficient total radiation.

Looking back over the work, there are one or two points on which some information might have been expected, but to which no reference has been made. The development of the magnetic detector which enabled Marconi to obtain some promise of results with high-speed automatic transmission and reception is among these. Attention is drawn in the treatise to the importance of using stranded wires for the construction of spirals carrying high-frequency currents on account of the eddy-current losses produced if solid wire is used, but though the quantitative aspect of "skin effect" resistance is elaborately treated, no quantitative treatment is afforded to the former, though it is, from a practical point of view, much more important. There is room also for a more complete treatment of the question of the theoretical design and construction of oscillation transformers. So far as those used in transmission are concerned, single-layer windings made with properly stranded wire are, doubtless, a design which it would be difficult to improve upon, but the same argument cannot be applied to coils for receiving purposes in which questions of dielectric strength are not concerned. In the latter case there would appear to be some scope for improvement in the direction of obtaining maximum inductance with minimum length of conductor, or some good reason why this principle cannot be applied.

The work, as a whole, forcibly brings out once again Dr. Fleming's admirable faculties for collecting together and arranging in sequence all the cream of up-to-date work on any electrical subject, and his not less useful faculty of being able at once to discriminate and sift the sound from the unsound. This is evidenced by the absence from the work of any reference to many pseudo systems and researches which have attained considerable notoriety, and have been given unmerited prominence in by far the larger number of books on this fascinating subject. In this alone he has done a service not to be too lightly valued.—J. E. Taylor.

Steam Turbines, with an Appendix on Gas Turbines, and the Future of Heat Engines. By Dr. A. Stodola. (Second edition.) London: Archibald Constable & Co., Ltd. 1906. Price 21s. net.

Despite four prefaces, with sentences manifestly of Germanic origin, one preface each (respectively by the author and his translator, Dr. Loewenstein) for each edition, we can only repeat the cordial welcome which we accorded to the first edition. Dr. Stodola's work has been throughout of the highest character. Primarily the book is written for the designer, but in addition Dr. Loewenstein commends its use as a text-book for students of high-grade engineering schools. He has used it himself for "the senior classes at Lehigh University," which "proves that the work is not too difficult for students of our best schools." The reviewer's opinion is that this remark only applies, so far as Great Britain is concerned, to university colleges where the student's preliminary courses in physics and mathematics have fitted him to use this book for reference purposes. It is primarily the designers' hand-book, its appeal to the general engineering reader lying in speculative chapters on gas turbines and the future of heat engines.

Slight differences in arrangement mark the second edition. For instance, there is an opening elementary introduction to the theory of steam turbines written for the special behoof of readers who are in practical work. This introductory matter avoids following the changes of heat conditions, presenting, instead, empirical formulæ which take into account a large part of the friction losses.

Accounts are also given of a number of experiments in regard to the steam friction of rotating disks, these being based on some experiments on the frictional resistance in air. From these air experiments, Dr. Stodola enunciates the following law:—"The work of rotating wheels and disks without load in the open air, or in an enclosed space, increases very approximately as the third power of the number of revolutions." The density of the surrounding steam atmosphere has also been studied, as also the effect of superheat, and the author's results are summarised as follows:—"The work of friction of a wheel in saturated steam with equal specific weight, equal size of wheel and equal velocity, is 1·3 times that in air. The work of friction of a wheel in superheated steam at atmospheric pressure and 300° C. (572° F.) is the same as that in air."

On the practical side accounts are given of detailed experiments on Zoelly and Rateau turbines. Other reports are given concerning the Riedler-Stumpf, Lindmark, Gelphke and Schulz turbines.

The author also deals with comparisons between the steam turbine and the reciprocating engine. On page 318, one finds one of the very rare awkward translations, to which all translators are liable. Speaking of early prejudices the author says: "There was doubt as to how long the high economy found in the new machines would be maintained, because the wear of the bearings, the wear of the blades, and incorrect installations would increase the losses due to leakage, and decrease the efficiency." "Faulty erection" would certainly read more fluently than "incorrect installations." On the subject of economy, the conclusion is that the steam turbine working with moderate superheat has overtaken the compound reciprocating engine in steam economy, but that the triple-expansion engine has still an advantage of about 8 per cent. of the steam consumption. On the question of the variation in steam consumption with over-load or under-load conditions, a very important point is made that as normal full-load ratings vary very considerably, full-load should be reckoned as the most favourable steam consumption per KW.-hour. Working on this basis, which seems an eminently equitable one for the purpose, the author states on page 322 that "the over-load with the Westinghouse turbine is very much less favourable than with the reciprocating engine; but with the Curtis, again, very much more favourable. The superiority of the reciprocating engine, therefore, with respect to the character of the steam consumption curve at various powers, is also doubtful. The choice between turbine and reciprocating engine depends considerably, therefore, on the degree of reliance which the purchaser places in the safety of operation of the two motor types."

Finally, in regard to the fascinating matter of speculative interest to which we drew attention when reviewing the first English edition, we have to note its re-appearance *in toto*. Nothing at all has transpired which is likely to bring into question the author's sound conclusions. We are still waiting for the metallurgist to give us an alloy maintaining its strength and other qualities up to and beyond a red heat. Those who look for the production of the ideal gas turbine are yet likely to have to wait a considerable further time for the success of their ally, the metallurgist.

Bases d'une Théorie Mécanique de l'Electricité. By M. Seligmann-Lui. Paris: H. Dunod et E. Pinat. 1906. Price 3 fr.

We never realised before what a great help a preface is to a reviewer until we got this book to review. Refereeing a mathematical paper for learned and other societies is mere child's play in comparison with reading this book. We managed, however, to find the time to read it, and it has well repaid our labour. We do not criticise the work, as our criticism would be essentially mathematical, and out of place in this journal.

The author is a physical mathematician of a high order. His analytical work is possibly less powerful, but it is far more finished than that of Oliver Heaviside. In reading parts of this work we were reminded of some of Lord Kelvin's earlier papers, but the views expressed are very different.

Starting from the principle of the Conservation of Energy, and that an electric charge may be positive or negative, the author deduces by very powerful methods the ordinary equations of electrostatics and electrodynamics which are found in Clerk-Maxwell. No supposition is made of an ether or of action at *appreciable* distances. It is not admitted that electric waves are the same as light waves. There is no

phenomenon in optics corresponding with the induction of currents in electricity. It is sometimes said that phosphorescence and fluorescence are such phenomena, but the analogy is too vague to be taken seriously. Induction effects are produced in every conductor, but phosphorescence and fluorescence depend essentially on the nature of the material in which the phenomena take place.

The simplicity of the laws of Coulomb and Ampere arises from a geometrical property of small deformations of a body. In this case only the first differential coefficients of the forces occur in the approximate equations of elastic solids, and they give rise to simple results. According to the author's view, the laws of Coulomb and Ampere are only approximations. The suggestion is made that electric energy is the same as thermo-dynamic potential. Assuming this to be true, it is shown that the whole of electrical theory may be reconstructed without saying a single word about kinetic or potential energy. It is only necessary to assume that the stable position of every system corresponds to that of minimum thermo-dynamic potential.

In a note, Maxwell's method of applying Lagrange's equations to electro-dynamics is criticised. Maxwell virtually assumes that the equations are identical with those of an incompressible fluid in hydro-dynamics. The energy is assumed to be entirely kinetic. It seems to us that the author is right in his contention, and that Maxwell's assumptions, at least, invalidate his proof of the formulæ, if not the formulæ themselves. In conclusion, we recommend the book to everyone with a knowledge of mathematical physics. He will find it profoundly suggestive, and if the author shakes the cherished beliefs of the orthodox electrician, he points out a new foundation on which to rest his well-tried formulæ.

The Electron Theory. By E. E. Fournier d'Albe, B.Sc. (Lond.), A.R.C.Sc., with a preface by G. Johnstone Stoney, M.A., Sc.D., F.R.S. London : Longmans, Green and Co. 1906. Price 5s. net.

This most important work will be welcomed by all those who are interested in the present trend of scientific thought regarding electrical matters.

The book consists of 17 chapters, occupying in all about 300 pages, and includes an historical preface by Dr. G. Johnstone Stoney.

It deals with the origin and development of the electron theory, the electric discharge, thermo-electricity, magnetism, electricity and light, magneto-optic phenomena, electricity, heat and magnetism, including chapters on radio-activity, &c., and a most interesting one on units.

The chapter on the electric discharge is particularly interesting, dealing, as it does, with such commonplace things as Ohm's Law, which, without the electron, is a physical mystery. It will probably be news to many "that electricity is a fluid, and indeed a gas, possessing a pressure of several thousand atmospheres in most metals, and having the same temperature as its surroundings. What distinguishes it from ordinary gases is the enormous expansive force it possesses apart from its temperature. . . . . Nor is electricity really incompressible. It can be compressed to the extent of about a millionth, as is done in charging a conductor with a high negative charge."

The trouble with most engineers (and even with many teachers of science) is that, however willing they may be, they have but a limited time at their disposal in which to keep themselves up to date in physical developments. At present the electron theory is dealt with in scattered papers, mostly highly mathematical, and many in foreign languages ; consequently it is most difficult to trace the various phenomena dealt with.

This work sums up all that has been done, and is so admirably written that anyone can follow the theory from beginning to end. Here, for instance, the engineer will see how current is conducted through metals, electrolytes and gases ; he will see also how the "molecular magnet" is now replaced by revolving electrons, which account for the facts of both ferro- and dia-magnetism.

To teachers the book will be of immense assistance, as it enables one to take a broad view of the whole matter, hitherto an impossibility.

The chapter on "Electricity and Light" treats the subject from the point of view of Profs. Drude and Schuster, and many consequences of Drude's equation are clearly explained. For instance, double refraction (always a difficulty) is explained thus :—

. . . "When a beam of light is sent through calcspar at right angles to the axis, only two electrons per molecule take part in the vibration . . . . hence the refractive index is small, and the velocity of propagation great. When on the other hand a beam of light is sent along the axis, all the five electrons are free to take part . . . Hence light is more slowly transmitted along the axis than across it. This gives rise to the phenomenon of double refraction."

Again, magnetism is discussed very clearly :—

"The atoms of all bodies are surrounded by several electrons describing orbits round them like the planets round the sun. When the orbits are nearly in the same plane, as in the Solar system, the bodies are magnetic, or rather para-magnetic, like oxygen and aluminium. When in addition the orbits are large enough to influence each other across the average distance separating the atoms, the bodies are ferro-magnetic, like iron, cobalt and nickel. When on the other hand, the orbits lie in various places . . . . the bodies are diamagnetic."

The author is to be congratulated on writing such an interesting work which assuredly will be widely read.

Engineers will feel after reading it that, at last, they have got a "common-sense" theory. What will happen when they get a real grip of it the reviewer does not know; but even now with magnetic (manganese) alloys, bismuth strips altering their resistance in magnetic fields, and Hall, Leduc and Ettingshausen effects (*vide* Chapter XIV), there are a few finger posts indicating some directions in which things at present only vaguely dreamt of, in our philosophy, may come to pass.

Nothing further need be said, except that the printing, and the frontispiece, are excellently done.

Railways and their Rates. By Edwin A. Pratt. London : John Murray. Price 5s.

To say that this book is powerful is to admit that it is well written, and however much the title may repel the general reader (that butt of the delicate R.L.S.) it is to him and not to the technical or particular reader that it is addressed, and it is to him that it will appeal.

Obviously written on behalf of the railway companies, nevertheless it is to all appearance so fair to the other side that the reader's sympathy is at once enlisted in the writer's cause, and his opinions are truly adamant who does not find them moulded more in the midway of the open mind.

The public as a body believes religiously that the majority of railway rates are based on no more scientific or equitable foundation than the greedy desire of the companies to get the utmost penny out of the trader, and the traders take care to foster that belief, by writing furious letters to the newspapers in the silly season, declaring that British trade is being killed because the freight on butterfly wings from New Zealand is less than the carriage of coals from London to Newcastle. Mr. Pratt deals fully with these declared injustices, and illustrates them with concrete examples. For instance, he shows very good cause why the carriage of foreign food supplies, such as frozen meat from America, butter, cheese, hams, and the like compares so favourably with the carriage of similar produce deriving from our own farmers. The whole thing is a question of bulk *versus* paltry parcels, and a few photographs at the end of the book illustrate it convincingly.

The moral is, of course, that the companies will give—must give, indeed—equally advantageous rates to English as to foreign traders whenever the conditions are equal.

Several instructive chapters explain, in a manner which is extraordinarily lively, having regard to the nature of the subject, how Continental produce is enabled to compete with English produce, because of the special exportation rates which the State railways grant at loss to themselves, *i.e.*, to the home traders, and the advantages of an all-sea direct service are demonstrated.

Naturally enough, the grievances of the companies are not omitted, nor should we wish them to be. The chapter

on the taxation of railways is calculated to draw tears of sympathy from a crocodile. During the 13 years, 1891 to 1903, local rates have doubled. They reached 4½ millions in 1903, and have advanced since at the rate of ¼ million per annum.

During the 12 years ending with 1904 the gross receipts of the L. & N.W.R. increased 22½ per cent., but the rates and taxes ran up 94 per cent., and the table below is an example of the justice meted out to the same company :—

TABLE I.—Proportion of Local Rates Paid by Railway Company.

	No. of parishes.	Railway Co.'s assessment.	Total rateable value of parishes.	Railway Co.'s proportion.
A	6	£24,029	£28,625	83·9 %
B	12	62,439	83,642	74·7 %
C	19	69,112	108,046	64·0 %
D	45	220,872	404,514	54·6 %
	82	£376,452	£624,827	60 25 %

In 53 out of these 82 parishes the company has no station.

Another table on similar lines shows how the company's assessment is anything between 67 per cent. and 86 per cent. of the assessment of the whole parish, while the proportion of land in the parish occupied by the company rises, as an extreme instance, to 5 per cent.

These facts go some way towards explaining why the average dividend on ordinary stock has come to such a low level.

TABLE II.

Number of companies.	Stock and share capital.	Loans and debentures.	Total paid-up capital.	Last dividend on ordinary stock.
29 ...	£651,811,271	£240,124,033	£891,935,304	4·93 %

Mr. Pratt finds it necessary at this time of day to explain fully why the old cry of equal mileage rates is unreasonable, and the fact that it is still raised makes one ready to believe that much of the traders' groaning is an affectation of business.

Half the book is occupied with the conditions existing on Continental railways, all, of course, having a definite bearing on the main subject, and we have found this part quite as interesting as the first half. Particularly so are the chapters which outline the events which led to the nationalisation of the railways in the leading Continental States.

We have nothing but praise for the way in which this book is written, printed and got up.

Radio-Active Transformations. By E. Rutherford, D.Sc., L.L.D., F.R.S. London: Archibald Constable & Co., Ltd. 1906. Price 16s. net.

As stated in the preface, this work contains the subject matter of 11 lectures delivered under the Silliman Foundation at Yale University in 1905.

Since the lectures were delivered, much scientific work has been carried out, and the results have been embodied by the author in the present volume.

The book consists of some 11 chapters dealing with such things as "The Radium Emanation," "Transformation in the Active Deposit of Radium," "Origin and Life of Radium," "The Production of Helium from Radium," "The Transformation of Matter," "Properties of the α-rays," &c.

In the chapters on the α-rays, the argument for regarding these as atoms of helium is clearly set forth, and the celebrated Ramsay-Soddy spectroscopic experiment discussed. Another most interesting chapter is that on the "Origin and Life of Radium." Its parentage is fully discussed, and very interesting geological evidence, &c., is given, showing what is known regarding its connection with uranium. Recently Boltwood (*vide* letter in *Nature*) has shown that apparently actinium fills a gap here.

The speculation regarding the age of the earth is also discussed, and seemingly the earth may have been habitable a thousand million years ago.

Since all matter appears to be more or less radio-active (see also *Proceedings*, Camb. Phys. Soc., "Radio-Activity of Metals and their Salts," N. R. Campbell), and the property is apparently an atomic one, it is almost impossible after reading such a work to avoid speculating on what was the primordial substance out of which the so-called elements were generated. On page 194 the author points out that the building-up of the undoubtedly heavy atom of radio-active substances may be going on under the very high temperatures and pressures which exist in the interior of the earth. This may account for the high density which the interior undoubtedly possesses, and Airy's observations on "the feet of the mountains." Again are we forced to speculate on what are going to be the ultimate substances. Here, however, the electronic theory of matter will probably throw light, and it is a question of stable and unstable combinations of electrons.

The reviewer can only add that the work is most interesting, and will be a welcome addition to the literature of this subject. It is very lucidly written, so that it is quite suitable for those seeking even general information.

Of course, the book deals with much of Prof. Rutherford's own work, so that the reader obtains his information direct from the original investigator, a very great advantage at this stage.

Report of the Electric Railway Test Commission of the Louisiana Purchase Exposition. New York: McGraw Publishing Co. 1906. Price $6.00 net.

"The organisation of the Electric Railway Test Commission was due to the recognition by the officials of the Louisiana Purchase Exposition of the fact that the presence of a large amount of electric railway apparatus, gathered together for exhibit purposes, offered an exceptional opportunity for obtaining practical and scientific information of equal interest to the producer and to the user of electrical machinery; and of the further fact that such investigations could most advantageously be carried out under the auspices of the Exposition."

Thus the introduction. The report describes in full detail the apparatus employed, the methods used and the results obtained in a series of 61 tests, many of which are of the greatest interest and importance, although some might easily have been spared. The tests comprise service, acceleration and braking tests on various city and interurban cars, compressor tests of a storage air-brake system, tests of a storage battery industrial locomotive, tests of alternating-current losses in track, as well as in rails and other steel sections, and tests of the resistances offered to the motion of interurban cars, particularly of the forces due to air resistance on car bodies and vestibules.

It will be seen from the above list that the tests are not concerned to any great extent with electric railways as we understand the term in this country, but rather with what we should describe as tramways and interurban light railways. Not that American interurban cars are necessarily smaller or lighter than ordinary English passenger coaches, but they are very different in build, and are operated, like tramcars, in single units, stopping when required to pick up or set down passengers, rather than in trains making definite schedule runs. To English readers interested in the electrification of main line railways, therefore, the book, although not without interest, will hardly realise the expectations that its title would be apt to raise.

The description of tests and the presentation of the results demand a peculiar genius for skilful selection of the essentials and for their arrangement in logical order, coupled with a capacity for happy expression which shall indicate briefly and clearly, but without unnecessary detail, exactly what has been done, and what general conclusions are derivable from the tests. Without expecting the editor to possess the genius of a Faraday, we believe the report under review could have been presented in a much more concise and readable form. In truth, it suffers considerably from over-elaboration, and is burdened with a tiresome wealth of minute detail, much of which is irrelevant and much would have been granted by any reader capable of deriving benefit from the book. It is, in fact, a somewhat

stodgy work. The meat is there, but it is mixed with such a quantity of indifferent pabulum that the reader is quite as likely to attain to somnolence as to satisfaction. The work being under the supervision of able committees, and adequate means being at the disposal of the testing staff, it is surely unnecessary, for instance, to explain, for the benefit of a reader requiring information on the impedance of rails, how a single-phase supply of power at suitable frequency and voltage can be obtained from a three-phase supply at 25 cycles and 6,000 volts. The matter presents no difficulty, and such details only encumber the report and distract the reader's attention.

The description of the cars and equipments again is principally composed of matter which in no way affects the tests, and is neither unusual nor particularly interesting. "The rear compartment," we are told of one of the cars, "is provided with Hale and Kilburn reversible seats upholstered in deep blue plush; the smoking compartment contains ten comfortable wicker chairs. The cars are carpeted throughout with Wilton carpet." . . . . . "The car is equipped with a Mosher headlight, and is also supplied with an oil and tool box hung under the car and containing two oil cans, one waste can, one coupling bar, two packing irons, one wreck rope, two pick-ups, and three flags,"—and so on *ad nauseam*.

Whether all this is intended as a sop for the companies who so kindly lent the cars and apparatus, or whether, like Pooh-Bah, the editor felt that he was adding local colour and artistic verisimilitude to an otherwise bald and unconvincing narrative, the reader is liable to experience a feeling of irritation in being compelled to search for his needles in unnecessary haystacks.

Following upon 32 pages of introduction, some 300 pages are devoted to service, acceleration, and braking tests on a single-truck city car, a double-truck city car, and an interurban car. This portion of the report particularly might have been very much condensed. The tests furnish results of interest only in so far as the conditions are typical of those generally met with, and except to the Indiana Union Traction Company, are not important in detail; they do not demonstrate anything of a striking nature, nor are they the first series of the kind that have been made. The results are of a nature that the operating engineer of a traction company should obtain for his own system, but it would be folly to apply them where the voltage, the grades, the average speed, the frequency of stops, the weight and size of cars, the driving equipment, the characteristics of the driver, the brake leverage, &c., are different from those met with in the tests. The chapter on tests of the storage battery industrial locomotive is of no great interest or importance.

The remainder of the report deals with matters more worthy of the attention of the Commission. The series of tests on alternating-current losses in rails and other steel sections is, we believe, the most exhaustive and complete that has yet appeared on the subject, and furnishes data of considerable value to those investigating the merits of single-phase operation.

The most important chapters of the report, however, which would by themselves justify the labours of the Commission, deal with train resistance, and the resistance offered by the air to moving car bodies and vestibules. Most of these tests were carried out on a car specially designed for the purpose, in which the body was arranged to be capable of movement, independently of the underframe, with as little friction between them as possible. The force transmitted from the underframe to the body was so directed as to be easily capable of measurement. Vestibules of various kinds —flat, standard, parabolic and wedge-shaped—were designed to fit the car body, and so suspended that the force with which they reacted on the car body could be determined. The tests demonstrate the great effect that the shape of the vestibule has on the air resistance, especially at high speeds. At 50 miles per hour, for instance, a parabolic front vestibule is shown to offer about half the resistance of a standard vestibule, whilst a parabolic rear vestibule gives rise to less than a quarter of the suction of the standard. In the case of a single car the greater part of the air resistance is chargeable to the vestibules, and, in fact, it was found impossible in so limited a series of tests to determine the amount that is properly chargeable to friction on the side of the car body itself.

It is not the reviewer's business to make suggestions, and it is unwise on the part of anyone who is not conversant with the exact conditions and arrangements to do so, but at the risk of submitting something which is impracticable under the circumstances, or which has been tried and found useless, we will offer two suggestions, which we hope may prove of use if further tests are made. The first is, that in order to determine the air resistance due to friction on the side of the car body (which is of considerable importance when the cars are operated in trains), the vestibules should be fixed to the underframe and independent of the main body, which is thus left free to move. The second suggestion is that the effect of grade and acceleration on the readings, which is often large and not very accurately known, should be neutralised by means of a suitable mass inside the car, arranged to act on the dynamometer in the opposite direction to the action of grade or inertia on the body or vestibule with such leverage as to be equal in intensity to this. It would not be difficult to design the dynamometer levers so as to provide for this mass, which, we believe, would have a tendency also to steady the dynamometer readings.

Altogether the results are suggestive and important, and we hope that further tests will be made with the car, in order to clear up some of the outstanding points. We must protest, however, against the misleading practice which has been adopted in some of the curves of extending them considerably beyond the range of the tests. The curves are not very reliable, even over the range covered by the tests (from 20 to 60 M.P.H.), as will be realised on consideration of the distance of some of the test points from them, and the extension of the curves to 100 M.P.H. is quite unjustified. The grotesquely inconsistent results given by the different formulæ that have been proposed for train resistance are principally due to these being applied to conditions and ranges of speed not in accordance with the tests from which they were derived.

The book is well got up and contains numerous folding plates, curves, diagrams and half-tone blocks, of which the last are not always first class. The picture of a Westinghouse No. 85 motor on page 68 has been inserted upside down, whilst the curve on page 566 has been put in sideways.

THE GERMAN ELECTRICAL INDUSTRY.

THE financial scheme put forward by the Continental Co. for Electrical Enterprises, of Nuremberg, has been successful, as was expected from the fact that the Schuckert Co. holds nearly all the ordinary share capital, amounting to £1,600,000. The shareholders were asked to pay an additional sum of £17 10s. per share for the purpose of extinguishing the debit balance of £92,500 and writing down the value of the assets, and holders representing £1,550,000 have accepted the proposal, which carries with it the transformation of these shares into preference shares.

The Siemens Electrical Operation Co., of Berlin, has just made an issue of ordinary shares amounting to £125,000, and of 4½ per cent. bonds totalling £125,000. The proceeds are intended for the purchase of three electricity works in Austria, for extensions of works already belonging to the company, and for providing funds for the completion of further transactions.

The Austrian patents for the Elektra steam turbine have been disposed of by the Electrical Industry Co., of Carlsruhe, to the Skoda Works, of Pilsen. The patents for Belgium, France, Spain and Italy were sold to companies in those countries some time ago.

The South German Cable Works (Suddeutsche Kabelwerke) Co., of Mannheim, whose ordinary share capital now amounts to £150,000, realised gross profits of £44,493 in 1906, as compared with £37,534 in the preceding year. Including the balance brought forward, the net profits amount to £29,572, as against £23,458 in 1905. After making the usual allocation to the reserve fund and writing off £7,500 for extraordinary depreciation as in the preceding year, the balance allows of the payment of a dividend at the rate of 8 per cent. as contrasted with 7½ per cent. on a share capital of £120,000 in 1905.

The report of the Elektrochemische Werke, of Berlin, for 1906 shows gross profits amounting to £71,970, as compared with £52,500 in the preceding year. After writing off for depreciation and making other appropriations, the accounts indicate net profits of £57,862, as contrasted with £37,850 in 1905. It is proposed to pay a dividend at the rate of 9 per cent. on a share capital of £275,000, as against 7 per cent. in the previous year, to place £25,000 to the reserve and redemption funds, and to carry the balance forward to

the next account. The company, which is closely associated with the group of the Allgemeine Co., owns the Bitterfeld and Rheinfelden works, which are leased to the Griesheim-Elektron Chemical Works Co., and itself carries on oxalic acid works.

The following announcements of dividends have also been made:—Voigt & Haeffner, 10 per cent. for 1906, as compared with 7 per cent. in 1905; the Continental Telegraph Co., of Berlin, 11½ per cent. and 11½ per cent. respectively; the E. H. Geist Co., of Cologne, 8 per cent. and 7 per cent.; the Rheydt Electro-Technical Works (Max Schorch & Co.), 8 per cent. and 8 per cent.; and the Voltohm Rope and Cable Works, of Frankfort, 5 per cent. and 3 per cent. respectively.

The Westinghouse Elektrizitats Gesellschaft, of Berlin, which carries on business in Germany according to the manufacturing methods of the parent undertaking at Pittsburg, terminated the financial year 1905-6 with a deficiency of over £32,000 on an ordinary share capital of £50,000. A meeting has been held to consider a scheme of reorganisation, whereby the capital would be reduced to £15,000. It appears that the whole of the share capital is held by one interest.

The liquidation of the Union Electricity Co., of Berlin, whose undertaking was amalgamated with that of the Allgemeine Co. in 1904, is proceeding slowly. According to the accounts issued for 1905-6, the receipts from interest and rents were in excess of the commercial expenses, but the amount provided for obligations arising from old contracts has caused the deficiency of £79,400 in 1904-5, to advance to £89,100 in the past year. The balance-sheet shows that the company's share capital of £1,200,000 has been reduced to £140,000 during the year by the distribution of a liquidation instalment of 88 per cent., and this has lowered the company's credit with the Allgemeine Co., from £1,462,600 to £580,450. The bond debt stands at £515,000, being the same amount as in the preceding year.

The German Accumulator Works Co., of Weimar, which has not been able to pay any dividend since its formation in 1899, recently issued its balance-sheet for 1905. A slight loss was incurred, and this increased the debit balance to £7,277 on a paid-up share capital of £40,200. The Accumulator Works (Pollak), Co., which has a share capital of £100,000, shows slight profits arising from interest during the third year of the process of liquidation. These enable the existing deficiency to be reduced to £46,420.

TRADE STATISTICS OF SWEDEN.

The recently issued annual trade statistics of Sweden for 1905 give the following details as to the trade in electrical goods with various countries; the figures for 1904 are given for purposes of comparison:—

Imports.

	1904. Kronor.	1905. Kronor.
Motors, not electric.—		
From United Kingdom	118,384	143,973
„ Germany	64,539	51,867
„ Denmark	133,496	36,312
„ Norway	3,174	24,633
„ United States	—	44,794
„ France	183	22,016
„ Other countries	3,300	4,437
Total	323,076	328,032
Electric Machinery and parts thereof.—		
From Germany	695,121	504,371
„ United Kingdom	15,255	11,146
„ United States	—	6,319
„ Other countries	208,135*	16,582
Total	918,511	538,418
Electric Lamps.—		
From Germany	291,182	349,853
„ United Kingdom	133	371
„ France	—	1,617
„ Denmark	36,769	4,783
„ Other countries	9,844	3,180
Total	337,928	359,804
Electric Motors.—		
From Denmark	75,746	53,066
„ Germany	239,991	556,961
„ United Kingdom	3,286	20,643
„ France	—	3,306
„ United States	—	9,664
„ Other countries	4,183	3,238
Total	323,206	646,878

* Denmark, 204,788 kronor.

	1904. Kronor.	1905. Kronor.
Electric Meters.—		
From Denmark	53,612	4,454
„ Germany	338,633	322,708
„ United Kingdom	3,612	475
„ Other countries	1,632	305
Total	397,489	327,942
Copper Wire, twisted for cables, &c., not insulated.—		
From Norway	—	1,044
„ Germany	8,480	19,287
„ Holland	9,385	4,147
„ Other countries	859	544
Total	18,724	25,022
Ditto, covered with silk or other textiles.—		
From Germany	22,384	30,096
„ Other countries	848	112
Total	23,232	30,208
Ditto, armoured with lead, &c.—		
From Germany	3,458,438	3,558,167
„ Holland	314,653	401,228
„ United Kingdom	109,987	632,913
„ France	—	44,750
„ Austria	—	23,023
„ Other countries	243,457*	4,862
Total	4,126,535	4,664,943

* Includes Belgium, 148,995 kronor, and Denmark, 94,462 kronor.

Ditto, covered with caoutchouc, &c.—		
From Denmark	198	106,104
„ Germany	35,875	387,251
„ Other countries	17,388	161
Total	53,461	493,516
Ditto, otherwise insulated.—		
From Germany	466,752	610,272
„ United Kingdom	16,995	51,172
„ Austria	—	20,079
„ Other countries	39,381	1,784
Total	523,128	683,307

Exports.

Motors, except electric.—		
To Russia	54,850	420,372
„ Finland	16,545	41,623
„ Austria	—	39,100
„ Other countries	58,743	91,145
Total	130,138	592,240
Electric Machinery and parts thereof.—		
To United Kingdom	95,355	74,067
„ Russia	22,050	30,770
„ Other countries	131,893*	79,357
Total	249,298	184,194

* Includes Germany, 63,043 kronor, and Belgium, 35,350 kronor.

Electric Lamps.—		
To United Kingdom	103,959	66,250
„ Germany	54,087	15,542
„ Other countries	5,115	18,484
Total	163,161	100,276
Copper Wire, Cables, &c., insulated.—		
To Russia	15,194	71,677
„ United Kingdom	—	5,000
„ Finland	48,584	34,308
„ Other countries	52,499	1,037
Total	116,277	112,022
Scientific Instruments, including Telephones.—		
To Russia	637,310	606,103
„ Denmark	111,766	112,443
„ Germany	57,766	214,661
„ United Kingdom	1,749,465	2,267,985
„ Other countries	812,347	438,342
Total	3,368,654	3,639,534

Note.—Krona = 1/1⅓.

PRUSSIAN TRAMWAY REGULATIONS.

The Prussian equivalent of the Board of Trade regulations for tramways and light railways was issued recently. The most important clauses to our English eyes are paraphrased below:—Grades are to exceed 1 in 15 only for short distances, and after demonstration that loaded cars will descend safely under all conditions.

Girder rails, or the equivalent, are to be used, and the lips are to be high enough to enable ordinary wheeled vehicles to run on them.

Curves, with special exceptions, are not to be of less than 49 ft. radius.

Grooves must not be *less than* $1\frac{3}{16}$ in. nor wider than $1\frac{9}{16}$ in. except at curves. Widths as liberal would be acclaimed by the home tramway managers.

The distance from track centre to kerb must be at least half the width of the car. That is to say, the car must not overlap the pavement. On double track the centres are to be at least equal to the greatest width of the cars. Many Continental tracks run as close to the pavement as the minimum here required, and the regulation would not have been made in a careful country like Germany if the practice had been at all dangerous.

The Government takes the power station into its grasp, and requires that enough spare plant shall be installed to meet any traffic rush or failure, and this applies to any station which supplies power for traction.

Wheel flanges may be worn down to $\frac{1}{2}$ in. deep × $\frac{5}{16}$ in. thick for speeds up to $15\frac{1}{2}$ m.p.h.

All cars must have two independent brakes, of which one is to be a power brake; and they must be powerful enough to stop a fully-loaded car running at $6\frac{1}{2}$ m.p.h. on a dry rail within $19\frac{1}{2}$ ft. Presumably on the level.

Every passenger is to have a seat space of $19\frac{1}{4}$ in. width, which strikes us as being a good deal more than the minimum allowance here.

The electrical equipment of cars must be inspected every six months, and the entire car is to be subjected to a thorough inspection at least every two years. Detailed reports of such examinations are to be submitted to the department, which seems at first to be an onerous and somewhat unnecessary requirement; but the inspection periods, whether for equipment or complete car, are by no means too close, and detailed reports would be made to the general manager in any case, so that an extra copy for the official inspector means no particular trouble.

On lines constructed after the manner of railways, the track is to be examined daily if the speed is over $12\frac{1}{2}$ m.p.h., and every three days below that speed.

The maximum speed of trains (probably including single cars) is 19 m.p.h. on standard-gauge track, and 19 m.p.h. on metre gauge. Higher speeds may be allowed if the Minister of Public Works considers them justified. In this matter, then, we have much leeway to make up, as our *maximum* of *maxima* is 16 m.p.h., and that was only given last year.

Jacks and other emergency tools should be easily obtained, that is, they need not be carried on each car.

The management is to keep a full record of employés, which shall contain a statement of punishments inflicted and any other information which will give a clear idea of the character and ability of every man. These records are to be open to the inspection of the department or commission—who, moreover, can demand a test of any motorman or conductor, and may require the discharge of incompetents. We have no use for this kind of interference.

All outdoor employés must be over 21 years of age, and must pass a general medical examination, as well as examinations in their duties.

The maximum average day's work in a month is not to exceed 10 hours for motormen and 11 hours for conductors. As this includes days of rest it is unlikely that our bean-fed tramway men will seek jobs under German management.

These regulations take effect from the beginning of the year. Knowing the love of the Teuton for rules, and for meticulous precision, these have surprised us agreeably, and some of them might be incorporated in the next edition of the B. of T. memorandum.

PROCEEDINGS OF INSTITUTIONS.

Rail Corrugation.

By Joseph A. Panton, A.M.I.E.E.

(*Abstract of Paper read before the* Institution of Electrical Engineers, London, *March 21st*, 1907.)

The question of rail corrugation has until recently been surrounded with a great deal of mystery; and even at the present time great diversity of opinion still exists as to its real cause. It is because generalisation has been attempted without careful and detailed investigation that so much of a misleading character has been published on the subject. The author proposes to deal with the subject in a general way, confining himself to the practical side of the corrugation problem, without entering to any extent into the question of materials and methods of manufacture. In dealing with a subject of such fundamental importance, it becomes necessary to consider certain points, which, though familiar to all, would, from their very nature and bearing on the subject, leave the treatment incomplete if omitted. Little actual work has been done in connection with the subject under consideration, therefore few practical details are available.

Rail Grinding.—At present, as a partial remedy, we keep on grinding rails—and money—away, without making headway towards finding the actual cause of the trouble. The author finds that a coarse grit of carborundum (No. 16) used on a wet day with a medium file-cutting pressure, gives the best results. Rail grinding is, however, by no means a remedy, as the corrugations soon reappear, which indicates that we must look to the equipment, directly or indirectly, in contact with the rails, and not to the rails themselves, for the cause of the trouble.

Rails.—Seeing that the actual corrugations occur on the rail, it is but natural to suppose that their presence or absence depends on the quality of the rail. The author has come to the conclusion that no satisfactory evidence has yet been put forward in support of this view. In fact, enough evidence has now accumulated to contradict any rail theory that might be promulgated. The following, amongst others, are reasons why the rail theory fails to account for the presence or corrugation:—

1. Because rails manufactured by every firm in the world have corrugated since the advent of electric traction.
2. That the rails did not corrugate in the days of horse and steam cars.
3. That the check rails are corrugated to an equal degree, and parallel to that on the crown of the rail.
4. That rails did not corrugate so long as the armatures were built on the axle.
5. That it takes on the average three years to develop corrugations on a new system, and only three weeks on relaying with new rails thereafter.
6. That an ordinary railway rail taken from the straight road of an electrically-operated railway (where no corrugations occur), and relaid on a checked curve soon corrugates.

Further, corrugated rails have been tested, and found to contain all the chemical constituents, and to possess the physical qualities required of them. It has been said that the trouble is due to the chattering of the rollers at the rolling mills, owing to play in the pinions and bearings of the rolls driven by antiquated steam engines. For the sake of argument, assume this to be so. Why, then, is it that the rails on electrically-operated railways only corrugate on checked curves, the remaining seven-eighths of the track being perfect? And why does it take so long to corrugate tramway rails on a new system, and so short a time on renewals? And why are not corrugations found on our steam railroads, running at 60 miles per hour? Further, in this country and abroad we find corrugations 24 in. to 30 in. in wave length. If chattering is going on in the Middlesbrough rolls on so gigantic a scale, the noise of it should be audible for miles around.

The author's attention was first drawn to defects in rolling stock as a means whereby corrugation might be caused, by the action of a flanged brake block then being tried to keep down wheel flanges. The tendency of the flanged brake blocks was to cut into the outer edge of the wheel tire, and it appeared difficult to account for this peculiar action. Later on it occurred to the author that the bogie truck frame and the wheels were not acting in unison, especially when rounding sharp curves. The bogie-truck frame, by means of the hangers, communicated to the brake block a twisting movement, which caused it to cut the wheel tread. On reverting to the brake block without a flange no cutting occurred, but by judicious watching it soon became apparent that this block had a decided tendency to run off the wheel tread on one side, and cut into the flange on the other. On further examination, it was found that the frames were out of square and the axles out of line; this was due probably to the axle being geared at one end of the shaft only, the tendency being to form diamond-shaped truck frames. To prove this remarkable result of defective gearing, the author has only to draw attention to the case of the Liverpool Overhead Railway during the first nine or ten years of its existence, when the armatures were built on the axle, whereby a symmetrical drive was obtained. During this period, there was no sign of any corrugations. On introducing single-ended geared axles into the same bogies, a series of difficulties cropped up when running over the same rails, necessitating the renewal of rails on checked curves.

Many similar cases have occurred on tramway undertakings where the conversion from steam to electric traction over the same rails has brought about corrugation. Being geared at one end and mounted in a weak truck frame, the whole tendency is to push the frame out of square, and the axles out of the line, and as an examination of the wheel tires clearly indicates, a grinding action takes place between the wheel flanges and guard rails. The wheels soon become groove-locked when speed is attained, and the wheel flanges striking the check rail intermittently cause the whole axle to jump or oscillate in the groove, giving rise to intermittent skidding and producing the peculiar flattening of the rail, known as corrugation. Corrugations will also be found on the check rail, equal and parallel to those on the crown of the rail, which clearly demonstrates that the wheels oscillate in the groove. This soon brings about unequal tires on the same axle, which causes a momentary slowing or lagging behind of one tire, and this still further increases the tendency to locking of wheel tires, as can readily be seen by the severe indentations on the check rail, each indentation tapering off to nothing as the tire is freed. Immediately the tire is freed it jumps forward the required distance to bring it into line, producing a sort of case-hardening effect on the head of the rail which remains high, and as it is at the same time revolving, in doing so it scoops or grinds intermittent hollows in the rails, the wave lengths being determined by the speed of the car and elasticity of the track. In the matter of wheels we have clung to

old practices longer than might have been expected, having made few changes in their dimensions or contour, a matter which requires immediate attention; for as we have considerably increased the speed and weight of cars, the tread and wheel flanges ought to be suitably modified to adapt them to the new conditions. Again, the running of a $\frac{3}{4}$ in. thick flange in a 1 in. wide groove requires further consideration, especially when rounding curves.

Excessive Wheel and Flange Wear.—In the case of bogie trucks sharp flanges are produced on wheels in diagonally opposite corners of the truck, and square flanges on the mate wheels. This peculiarity has developed greatly since the advent of electric traction, and clearly indicates that the method of single-ended gear-driven axles has the tendency to send the geared end of the axle forward, hence the sharp flange on the wheel nearest the gear, which being the aggressor is found to be of smaller circumference than the mate wheel. The author has repeatedly measured differences in circumferences varying from $\frac{3}{4}$ in. to 1 in. We therefore arrive at an unbalanced condition of the car body, especially when rounding curves, which throws undue and constant pressure on the smaller wheels, and in the case of cars where we have no elevation on curves, the inequalities of wheel circumferences are further aggravated. It will also be found that in short wheel base trucks secured to the car body, the two smaller wheels will be on the same side of the car, thus making an unbalanced condition of the car whether running on the straight or curved track, which will tend further to increase corrugations where unequal rail level of the track exists. In serious cases this unbalanced condition has caused a cant or tilt of the car body, representing $\frac{7}{8}$ in. in 9 ft. 6 in. This accounts for the varying conditions of corrugations so often found on the straight track. Speaking generally, corrugations are most likely to be found in towns and cities where sharp loops and curves are negotiated regardless of speed with top-heavy canopy covered cars, and trucks that were never designed for such circumstances. Some twelve months ago a set of Corporation tramway trucks were put through the engineering shops, thoroughly squared up, planed, fitted and finished. These trucks were then put on a particular route, and it is very gratifying to hear that the wheel flanges are greatly improved, and the corrugations reduced to one-half their original size. One therefore arrives at the result that corrugations on electric railways and tramways are caused by weak bogie frames and trucks unable to withstand the side strains of our top-heavy cars, running at high speed on flat curves of short radii, the weakness being intensified by unsymmetrically driven axles being run through sharp loops and turnouts. Hence in towns where corrugations do not appear you will find a perfect track with trucks of sound mechanical design, preferably "former," built under refined engineering conditions. Recent trucks have been designed to permit of the wheels and axles moving laterally upon curves, but how much lateral play can be expected with a $\frac{3}{4}$-in. flange running in a 1-in. groove, admitting inequalities in track gauge?

Broken Axles.—Fractures generally occur on the geared side of the axle, where the shaft enters the hub of the wheel. A fractured axle appears to be short in the grain, as if all the nature had gone out of the steel. Samples of this material have been tested, and the tensile strength and ductility have been found to be up to the standard. The author is strongly of opinion that these fractures are caused by the skewed axles coming up to the curve at the wrong angle, this occurring when the axle is rigidly held in position by the motor on the geared side.

This skewing of axles is quite apparent on short chain curves, the check rail showing a decided cutting away of the ramped part of the check as the wheel enters the curve. It therefore appears that the only hope of saving axles at the present time is to keep the power switched off the motors as far as possible when rounding curves, so that the axles can move freely to suit the circumstances.

Roaring Rails.—Roaring rails are found principally on Indian steam railroads, and we can only surmise that the trouble originates in much the same way as corrugation. If a train is composed of more or less strained trucks, drawn by a locomotive, one might expect roaring rails; because the axles are free to lag and lock across the track gauge on any part of the road, according to the varying circumstances of the wheel tires. On the other hand, if the same train is driven by geared motors, the power of the motor overcomes the tendency of the wheels to lag, which therefore run steadily, though skewed and unchecked. It is only when such skewed axles meet checked rails that the leading tires tend to groove-lock. Then it is that the two combined effects (*i.e.*, the groove-locking and the wheel lag) are able to overcome the inertia of the motor, the opposing forces causing the axle to oscillate intermittently when checked. Hence corrugations can be produced at will, on checked curves or where checked rails are used, be it on the straight or curved track. In the case of electric railways, any light depressions the trailing coach wheels might make on the rail are obliterated by the harshly acting and heavy motor coaches that follow. We therefore find no corrugations or roaring rails on the straight unchecked track of electrically-operated railways. Roaring rails have most irregular ridges and hollows not confined to any one length, and quite distinct in appearance from corrugations, though caused by one and the same thing; add to this the climatic conditions and varying elasticity caused by the different qualities of ballast and packing, and we have a train supported by wheels of varying circumferences, unchecked in their career, lagging and hopping along a track consisting of inequalities in rail level. Hammered roaring rails are the inevitable result.

Electricity and Vibration.—The author fails to see why an ordinary tramway rail, laid in solid cement, should vibrate, unless it is caused to do so by the hammering action of skewed wheels, locking and oscillating in the groove, which in turn sets up a vibration of the car and rail. With regard to bridge-constructed railways, one can feel and hear the vibrations of the structure when the approaching train is $\frac{1}{2}$ mile off; yet there is not the slightest sign of corrugations on the straight track when no check rails are used. Take the average case of a tramway where the track is laid like an anvil, and the speed thereon is 10 to 12 miles per hour, you get corrugations of about 2 to 3 in. pitch. Compare this with elevated and bridge-constructed electric railways running at 30 to 36 miles per hour, you would expect to find corrugations in proportion—say, of 6-in. to 9-in. pitch; as a matter of fact, the corrugations on the checked curves referred to exceed these lengths considerably, due entirely to the elasticity of the track both horizontally and vertically. This proves that the wave length of corrugation varies with the speed of the vehicle and track elasticity.

Cable Cars.—We hear very little about corrugations with reference to cable traction, owing to the different method of applying the power to the axles. The speed not being high, the corrugations take considerably longer to form in the first instance. There seems no reason for doubting that corrugations on cable roads are brought about by weak trucks on flat curves, as it is here that the greatest damage of all is done. The unequal wheels oscillating in the grooves form regular corrugations of definite wave-length. As the width of the check rail varies, so will the pitch of the corrugations. It also follows that, as the longitudinal play of the axle increases, the corrugations will be formed at lower speeds. Hence the gradual extension of corrugations over the whole system, deeper at places according to the rail level and road camber.

Truck Design.—A large percentage of the trucks under our street cars are not capable of meeting modern requirements, because of the inability of the frames to withstand side strains. Such trucks may be cheap at the beginning, but constantly require repair, while at the same time they need more current to draw them, and are most expensive in the end. The present-day bogie-truck frames of rivetted and built-up construction, as used by most electric railway companies, carry the load in the centre, and are themselves supported upon equalising springs instead of on journal springs. This gives a short spring base for the frame, and in consequence, when the brakes are applied, the frame is pulled down at one end and pushed up at the other. The author has noticed frames tilting 3 in. or 4 in., bringing the life-guards down on the rail.

The equalising bar bears directly upon the axle box, and when the horn slides are worn the boxes take up a rigid position at an acute angle to the jaws of the frame causing a binding of the boxes, and producing the vibration so noticeable in trucks of this design. It is, therefore, necessary to give up the riveted and built-up construction of bogie frames on modern high-speed electric railways. It is the weakness in bracing the two sides together, especially under the axle box, that makes the present-day trucks unable to withstand the severe side strain they are subject to. It will, therefore, be necessary to supplement the present trucks with suitable under-frames well braced on either side of the wheels. In the author's opinion, the time is not far distant when we shall have brake blocks on either side of the wheel, especially for street traction. The difficulty with horn slides would then be obviated. Some careful observations have been made with reference to the effects of retardation on the rails. With heavy electric trains running at 40 to 60 miles per hour, only barely visible wavy skin depressions appeared on the rails after a hard application of the brakes, the depressions being distorted and finally obliterated by the next train. Sudden braking operates unfavourably on the superstructure, in the sense that the rails are subjected to vibration, and consequently the sub-structure gets separated, but this action has gone on for years at the same place without creating any impression upon the head of the rail. There is, therefore, no ground for assuming that the application of brakes has any connection with corrugations or roaring rails.

However erroneous these observations may seem, and however crude the suggested remedies may appear, they are the direct result of practical experience gained since the year in which accelerated electric railway traction made a substantial start, and the paper has been written as the direct result of several years' daily labour and thought.

Discussion.

The discussion was opened by Mr. H. M. Sayers, who agreed with the author that corrugation was largely due to the rolling stock employed. All the causes mentioned by the author could be reduced to chattering actions—we might say that vibrations of short period led to corrugation. Corrugations on one rail only were evidently due to torsional vibration, and generally appeared on the off-side or higher rail. The slight camber of a road often resulted in one side of the track being higher than the other, the latter taking extra weight and wear. He concluded that braking might sometimes cause corrugation, as at three of the Edinburgh cable tramway termini, where brakes were applied, corrugations were well marked. He had noted on the Streatham route of the L.C.C. ten places where corrugation occurred, all but one being at a stop—this he believed due to alternate slipping and rolling of wheels under brake action. Wheel flanges were much too close a fit to rail grooves on tramways; it was impossible to compensate for curves by widening the gauge, and the laying out of curves necessitated a careful study of the rolling stock. The ductile metal of the present-day rail was rolled up into hillocks, but if harder rails were employed this would not occur. He thought the hard rail ('6 carbon) was the cure for the trouble. Manganese assisted cold rolling, and even if its absence from the metal rendered the latter brittle, it was preferable in the end. The B.E.T. Co.'s lines, constructed between 1898 and 1903, were laid with hard German rails and had not corrugated.

Prof. Carus-Wilson, in analysing the causes of corrugation, said the latter usually appeared on curves of large radius, due to the skewing of the axles. The fact that an exchange of corrugated and non-corrugated rails in a track resulted in reversing the conditions of the rails, he thought, cleared the rail of blame. Tests showed that smooth rails were soft and roaring rails hard; the pitch of the corrugation dispensed with the suggestion of origin at the rolling mill gearing; from the irregular occurrence of corrugation, he suggested that it originated in the track laying, any irregularity in which might result in the car attacking a particular point on the track. Local conditions were the cause of roaring rails in India, and they were no doubt also partly responsible for corrugation over here. The author proved that distorted trucks were one cause of corrugation—but nothing further. He could not agree with the author that the distortion of the truck was due to side gearing, as both gear wheels were rigidly held in the motor frame, which took the reaction. He held that the corrugations on the Liverpool Overhead Railway track were not due to the adoption of side-geared in place of direct-driving motors, but were due to the 40 per cent. greater speed of the newer stock with 100 H.P.-motors, which gave 100 per cent. greater flange action as the cause.

Mr. Worby Beaumont could not agree with any part of the explanation in the paper. He suggested that the origin of corrugation was the rolling action set up on a track by heavy loads on small wheels. The same action was used in manufacturing steel and other metals, and its recurrence under running conditions must have some effect. He was quite satisfied that rolling compression resulted in pushing the material of the rail gradually forward, and it was then compressed by the running wheel. The difference in pitch of corrugations was due to the quality of the steel.

Mr. Hawtayne agreed that quality of rail material had a good deal to do with the subject. He had used, prior to the issue of the British Standard Specification, hard Belgian rails for six or seven years, and they had not corrugated.

Mr. W. M. Mordey said that the Standard Specification was not always adhered to, and that, after considerable trouble and many assurances of its impossibility, British makers had supplied him with hard steel rails.

Mr. J. S. Warner pointed out that the author was mistaken in supposing that the lateral play provided for in recent trucks had any connection with the flange movement in the groove of the rail; the car-body and truck actually moved laterally on the journals.

The author's reply will be communicated.

LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names may be made. Answers are furnished by a barrister-at-law.*]

No. 83.—*Private Supply of Electricity.—Advantages of Proceeding without Provisional Order.*

"Company" writes:—"A Town Council proposes to allow a private company to supply electricity within its area by means of overhead wires for street and private lighting. They will also support application by the company for a provisional order. Is it advantageous to proceed with or without such order, having in mind the following points:—

"*a*. If a provisional order is obtained, sanction of Board of Trade must be secured for overhead conductors.

"*b*. If a provisional order is not obtained, apparently such sanction is unnecessary.

"*c*. Without a provisional order, has sanction of frontager to be obtained to erection of any pole opposite his house or shop on footpath repairable by local authority, or does the local authority's permission for the undertaking obviate this?

"*d*. If a provisional order is obtained, do powers conferred to break up streets, allow of poles being planted, without consulting frontagers, both in streets and on footpaths repairable by local authority, and streets specified in Schedule 2 of order?

"*e*. Can any advantages be shown on the side of proceeding without a provisional order?"

*** With regard to (*a*) and (*b*), it is to be observed that even though there is no provisional order, the sanction of the Board of Trade must be obtained, in certain cases, before overhead conductors can be used. (See Board of Trade Regulations under the Electric Lighting Act, 1888, made in 1897, and set out in Shiress Will's "Law of Electricity," 3rd Edition, p. 261.)

(*c*) and (*d*). These are questions of some difficulty. It is very doubtful whether a local authority can authorise the placing of posts in the highway in front of a man's house, unless they have statutory authority. Should "Company" be unable to obtain the necessary permits from frontagers, he may have to go to the expense of a provisional order.

As to (*e*) the advantages of proceeding without an order are (1) enormous saving of expense; (2) no restriction as to the price which may be charged for electricity; and (3) no restriction as to area of supply.

EXPIRING PATENTS.

We are informed by Messrs. W. P. Thompson & Co. that about 750 complete applications for electrical patents were filed during the year 1893. Only 63 of the patents granted on these applications have been maintained for their full term, viz., 14 years, and being of considerable value, we give short abstracts of them below:—

238. "Electric meters." H. W. Sullivan, of London. January 5th, 1893. Current meters of the "Deprez-D'Arsonval" type. In order to obtain a strong field, the single magnet is replaced by two or more magnets. The deflecting moment is varied by altering the position of the coil in the magnetic field. To prevent the swaying of the coil, those parts of the suspension immediately adjoining the coil are made rigid and passed through a bearing attached to the support.

516. "Electric meters." H. H. Lake. (E. Weston, New Jersey, U.S.A.) January 10th, 1893. Current meters. Relates to recording voltmeters or ammeters. The main current from the dynamo passes through a conducting bar, in front of which moves a conducting pointer making contact with the conducting bar, and carrying a pencil which rests on a paper strip moved at a uniform velocity. The pointer is moved by auxiliary devices in accordance with the variations in the main current or (with suitable modifications) the voltage.

517. "Electric meters." H. H. Lake. (E. Weston, New Jersey, U.S.A.) January 10th, 1893. Current meters. Relates to damping devices and scale plates. In order to render a meter having a rotating shaft carrying an index dead beat, the shaft which, in one form of construction carries a cylinder upon which the wire conveying the current is coiled, is connected with another shaft carrying a disk of aluminium or other diamagnetic material, which moves between the poles of a small permanent magnet. The scale plate, which may be opaque or translucent (with a source of light placed behind it), is provided with flanges, by means of which it may be fitted in any required position in a recess in the meter case, and easily removed without disturbing the other parts of the apparatus.

518. "Electric meters." H. H. Lake. (E. Weston, New Jersey, U.S.A.) January 10th, 1893. Current meters.—Relates to voltmeters and ammeters, in which the movable coils are connected with a pointer, and are supported in a magnetic field produced by fixed coils, and are adapted to be deflected, when the circuit is completed, against the action of springs. To render the instrument astatic, and eliminate errors due to terrestial magnetism, the movable coils are wound in opposite directions. For use as a voltmeter, the fixed and movable coils are arranged in series, while for use as an ammeter they are joined in parallel. For correcting for temperature variations due to changes in the resistance of the coil, a thermometer is provided, together with a set of resistance coils which are arranged in series with the fixed coil. The contact pieces are so marked that, by moving the contact arm to the plate marked with the same number as that which represents the temperature, the resistance is maintained constant. Changes due to alterations in the temperature of the air are corrected for by means of a rod of carbon or other material, the resistance of which diminishes with an increase of temperature. In order to cause the index to move over gradually-increasing scale divisions for equal increments in the force applied, it is suitably connected with an arm which carries a weight.

519. "Electric resistances; Wheatstone bridge." H. H. Lake. (E. Weston, New Jersey, U.S.A.) January 10th, 1893. Resistance coils, &c.—Relates to an adjustable resistance and a method of arranging two or more sets of resistances, so that when a circuit is established through a given resistance of one series, an equal resistance of another series is simultaneously cut out. Wheatstone bridge.—The connections are so arranged as to enable the variations of resistance, usually requiring the use of 10 coils, to be obtained by the use of six coils, and the contact blocks are arranged inside the case on the underside of the top of the box.

520. "Electric meters; electric couplings." H. H. Lake. (E. Weston, New Jersey, U.S.A.) January 10th, 1893. Relates to a current meter and a coupling, by means of which it can be connected up to any required part of a circuit in place of a lamp. The coupling consists of an adapter which is applied to a lamp socket after the removal of the lamp, and a plug carrying terminals, which are connected with the meter.

583. "Electric meters." A. Wright, Brighton. January 11th, 1893. Current meters.—Relates to meters of the differential-thermometer type for recording the maximum or minimum current or electromotive force, or the extreme variation in the strength or E.M.F. of the current during a given period. In one form of construction one of the bulbs contains, or is surrounded by a coil or strip through which the whole or part of the current passes. The rise of temperature causes a movement of a column of liquid, the extreme positions of which are recorded by indexes. In cases where the indications form a basis of charge for the consumption of electricity, the scale may be so calibrated as to indicate directly the total number of units that must be consumed to average a daily use, for a given number of hours, of the maximum current recorded; it may directly indicate the discount allowable to consumers, or the varying price for current consumed consequent on the consumer using a given number of units per ampere, or may indicate the average number of hours per day the demand has been used. In a modification, the expansion of the air causes the column of liquid to move. Other modifications are described.

1,561. "Dynamo-electric machines." H. H. Lake. (R. Lundell and E. H. Johnson, New York, U.S.A.). January 24th, 1893. The field-magnet core is made up of two hollow cylindrical parts, from each of which one or more pairs of pole-pieces project into the annular space between the field coil and the armature. The single field coil is wound on a former or bobbin of a suitable shape, and is co-axial with the armature. When the parts are bolted together they form a cylindrical enclosing shell. Holes are provided for admitting air to the interior of the machine.

2,129. "Moulding: Dynamo-electric generators." R. Haddan, London. (C. W. Jefferson, New York, U.S.A.). January 31st, 1893. Relates to a mould for shaping mica insulators. Flat rings, made up of overlapping slips of mica connected by shellac or other cement, are pressed to channel section in a mould, which is first heated by steam and afterwards cooled by water which passes through a flat spiral conduit. This conduit is formed as a channel in one part of the mould, and is closed by a plate which is bolted against some packing.

2,703. "Electric cut-outs." D. Bates, London. February 7th, 1893. Fusible cut-outs for high-tension currents.—A fusible wire is placed in a hole drilled or formed in an insulating block. It is secured at its ends by a nut to sockets provided with blades which are adapted to fit between spring contacts carried on a base. The main conductor is secured to a binding post, and the other conductor to a similar device. The fuse wire should be made slightly thinner at the centre in order that, when the wire fuses, the rush of air and vapour may blow out the arc.

3,101. "Dynamo-electric machines." C. W. Jefferson, New York, U.S.A. February 11th, 1893. Armatures.—The annular insulating heads of the core are made by cementing together a number of rings, composed of overlapping mica scales, subjecting them to pressure, and before drying, moulding a flange on the inner and outer edges. The slotted insulators which fit into grooves in the armature core, and the curved insulators which are inserted between the spokes, are made in a similar manner. Other forms are described.

3,413. "Siphon recorder." A. Muirhead and R. H. Edgar, Westminster. February 15th, 1893. A siphon recorder is formed with a coil supported by wires and carrying a cross-arm. Suitably attached fibres connect the cross-arm to the siphon cradle, which is attached to a stretched wire. This wire is vibrated by means of an electro-magnet in a local trembler circuit. The stretched wire is carried by a frame provided with a wire or rod for preventing any harmful vibrations in the stretched wire.

3,785. "Lamps." J. Prestwich, Eccles, near Manchester. February 21st, 1893. Miners', &c., lamps.—Relates to oil lamps which can be ignited by electricity without opening the lamp.

3,786. "Lamps." J. Prestwich, Eccles, near Manchester. February 21st 1893. Miners', &c., lamps.—Relates to such miners', &c., oil lamps as are ignited by electricity without opening the lamp.

5,197. "Alkali, obtaining electrolytically." J. Hargreaves, Lancashire, and T. Bird, Cressington, near Liverpool. March 10th, 1893. Relates to the production of alkali, as caustic or carbonate, electrolytically. The electrolytic cell is divided into two compartments by a porous partition, to one side of which is attached the flat wire gauze cathode, a sub-divided carbon anode being arranged in the chloride solution on the other side. The chlorine evolved escapes through a tube, while the alkali is washed off the cathode by steam, mingled with air carbonic acid or other gas, admitted through another tube, and the caustic or carbonated alkaline solution obtained runs off through a drain tube. The porous partition may be arranged vertically, and several cells used at one time. The same apparatus may be employed generally for electrolysis. In cases where the cathode becomes polarised, a suitable metallic oxide or catalytic material, together with oxygen or an oxidising substance, is applied thereto.

5,198. "Electrolytic diaphragms and electrodes." J. Hargreaves, Lancashire, and T. Bird, Cressington, near Liverpool. March 10th, 1893. Diaphragms and electrodes, for use in electrolytic apparatus, are formed of pulp, such as asbestos mixed with lime, magnesia, &c., rendered insoluble by immersion in silicate of soda or potash. Wire-gauze cathodes are coated with the pulp, and are afterwards rendered insoluble so as to form a combined electrode and diaphragm.

6,225. "Posts." Siemens Bros. & Co., Ltd., and R. von Fischer-Treuenfeld, Westminster. March 23rd, 18 3. Metal tubular posts are secured in the ground by means of tubular sockets formed with a cone at the bottom and a screw thread at the top. The post is held in position by a split screw ring, and the socket is filled with cement or concrete. The socket is formed with a base plate or point which acts as a pile, or a buckled plate is employed into which the socket fits by means of a plug.

(To be continued.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1905.

Alternating-Current Dynamo-Electric Machines. Allgemeine Elektricitäts-Ges. 26,094. December 14th. (Date applied for under International Convention, December 15th, 1904.)

1906.

Gates for Electric and other Lifts. C. G. Major, P. H. Stevens and E. C. Stevens. 9,838. April 27th.

Machines for Use in the Manufacture of Incandescent Electric Lamps. British Thomson-Houston Co. (General Electric Co.) 10,904. May 10th.

Telephone and other Electrical Equipments for the Use more Particularly of Divers. J. Holman. 11,167. May 12th.

Electrical Incandescent Lamp-Holder Switches. W. McGeoch & Co. and W. T. Reynolds. 11,802. May 21st.

Electric Metering Panel Board. A. C. McWilliams. 12,463. May 29th.

Effecting the Drying of Galvanised Plates. J. Y. Johnson. (Firm Columbus Elektricitäts Ges.) 12,617. May 30th.

Terminals for Electric Accumulators. K. R. Smith. 12,773. June 1st.

Automatic Fire Alarms. J. Tatlock and A. G. Horne. 14,300. June 22nd.

Trolley Pulley of Overhead Wire Electric Tramways. W. H. Lowe. 15,400. July 5th.

Alternating Current Electric Meters of the Induction Type. Allgemeine Elektricitäts-Ges. 16,818. July 25th. (Date applied for under International Convention, July 25th, 1905.)

System or Method of Laying or Erecting Conduits or Casings for Electric Conductors. F. W. V. Park. 18,724. August 21st.

Sound Magnifier for Telegraphic Instruments. F. O. Hanson and W. Schrenkler. 19,413. August 30th.

Electric Arc Lamps. J. A. Rignon. 19,468. August 31st.

Electric Current Collecting Trolleys. J. T. Haudenshield. 20,231. September 11th.

Electric Commutators. H. W. Van Raden, C. V. Robinson and M. Metz. 21,719. October 2nd.

Electrical Measuring Instruments of the Moving Coil Type. J. W. Record and H. Bevis. 23,953. October 27th.

Battery Testing Apparatus. E. Fauvin, E. Amiot and E. Cheneaux. 24,390. October 31st.

Electrodes for Electrolytic Purposes. P. Ferchland. 24,806. November 5th. (Date applied for under International Convention, November 9th, 1905.)

Electric Stamp Hammers. A. C. J. Guenee. 3,119. February 8th.

Manufacture of Incandescing Bodies for Electric Incandescent Lamps. A. Just, F. Hanaman, H. Landesberger, I. Salzmann and Vereinigte Electricitäts Akt.-Ges. 3,213. February 9th.

Apparatus for Producing Nitric Oxide by Electricity. I. Moscicki. 3,583. February 13th.

Dynamo-Electric Generators for Firing Mines and the like. H. Davis. 3,604. February 14th.

Manufacture of Incandescing Bodies for Electric Incandescent Lamps. A. Just, F. Hanaman, H. Landesberger, I. Salzmann and the firm Vereinigte Electricitäts Akt.-Ges. 3,684. February 14th.

Electro-magnetically Operated Switches. British Thomson-Houston Co. (General Electric Co.) 3,781. February 15th.

Electric Measuring Apparatus. British Thomson-Houston Co. and F. Holden. 3,904. February 16th.

Manufacture of Incandescing Bodies for Electric Incandescent Lamps. A Just, H. Landesberger, I. Salzmann and the firm Vereinigte Electricitäts Akt.-Ges. 4,081. February 19th.

Apparatus for Measuring, Indicating and Registering Speed by means of a Dynamo in Combination with a Solenoid Provided with a Core Whereby the Indicator is Actuated. W. Mecke. 4,102. February 19th.

Insulation of Metal for Electrical Apparatus. British Thomson-Houston Co. (General Electric Co.) 4,925. February 28th.

Electric Fusible Cut-Outs. O. L. Peard. 5,170. March 2nd.

Brush Holders for Dynamo-Electric and Similar Machines. Vickers, Sons and Maxim, Ltd., and G. H. Lindley. 5,465. March 6th.

Electrical Resistance Units. British Thomson-Houston Co. (General Electric Co.) 6,193. March 14th.

Manufacture of Reed Combs for Use in Indicating the Frequency of Electrical Alternations or Mechanical Oscillations. C. G. M. Hardingham. (Hartmann & Braun Akt. Ges.) 6,933. March 22nd.

Construction of Dynamo-Electric Machines. E. S. G. Rees. 7,725. March 30th.

Electric Capstans and the like. W. P. Thompson. (Soc. Lyonnaise de Mecanique et d'Electricite.) 8,347. April 6th.

Electrical Apparatus for Transmitting and Receiving Signals for Controlling the Fire of Guns. A. T. Dawson and G. T. Buckham. 8,902. April 12th.

Filaments of Incandescent Electric Lamps. A. Bourdos, R. Rothschild and J. W. Sutcliffe. 11,279. May 14th.

Electric Couplings for Portable Telephone Sets. G. H. Metheany. 11,869. May 21st.

Electric Controllers or Switches. W. Fairweather. (Electrical Devices Co.) 12,477. May 29th.

Magnetic Compasses. C. Barker. 12,777. June 1st.

Telephone Exchange Apparatus. W. Aitken. 13,312. June 9th.

Electric Motor Controllers. J. P. Durkin. 14,073. January 8th. (Date applied for under International Convention, January 8th, 1906.)

Regulation of Continuous-Current Motors. C. H. Iles and W. Armistead. 14,433. June 23rd.

Electric Clocks. H. J. Haddan. (Kutnow Bros.) 14,614. June 26th.

Single-Phase Alternating-Current Series Motor. M. Latour. 14,696. June 27th. (Date applied for under International Convention, June 28th, 1905.)

Electrical Winding Apparatus for Clocks and the like. Schneider and Wesenfeld Ges. 15,022. July 2nd. (Date applied for under International Convention, March 7th, 1906.)

Primary Galvanic Elements. E. W. Jungner. 15,727. July 11th. (Date applied for under International Convention, July 12th, 1905.)

Control of the Speed or Working of Motors or other Machines from a Distance or Otherwise. Siemens Bros.' Dynamo Works, Ltd. (Siemens Schuckertwerke.) 19,593. September 3rd.

Electric Current Collecting Trolleys. H. J. Haddan. (J. A. Caldwell.) 20,130. September 10th.

Brush Holders for Dynamo-Electric Machines and the like. Veritys, Ltd., and D. E. Rogers. 21,050. September 22nd.

Cord Grip for Suspending Electric Incandescent Lamps. J. Jessel. 21,580. September 29th.

Alternating-Current Commutator Machines Having Compensation Windings. (Siemens Schuckertwerke.) 22,605. October 12th. (Date applied for under International Convention, June 13th, 1906.)

Method of Attaching an Electric Lead to a Dynamo Brush or the like. W. S. Rawson. (H. Gerard.) 22,873. October 16th.

Binders for Telephone Switchboard Cords. R. J. Skelton and A. H. Ware. 24,078. October 29th.

Telephone Transmitters. W. Aitken. 27,178. November 29th.

Incandescent Electric Lamps Containing Mercury Vapour or the like. R. Hopfelt. 29,616. December 29th. (Date applied for under International Convention, January 16th, 1906.)

Accumulator Grid. J. G. Roy. 4,355. February 22nd.

Pulsion of Perambulators and Bath Chairs by Electrical Motors. W. H. Dunkley. 4,356. February 22nd.

Electro-Mechanical Devices for Producing Corresponding Positions in Transmitting and Receiving Apparatus. A. Barr and W. Stroud. 4,422. February 23rd.

Electric Arc Lamps. A. Blondel. 4,677. February 26th.

Secondary Batteries. H. W. Lake. (Rhode Island Electromobile Co.) 4,700. February 26th.

Charging and Discharging of Secondary Batteries. L. Fiedler. 4,702. February 26th.

Magnetic Clutches. H. W. Ravenshaw, V. G. Middleton and W. E. Townsend. 4,849A February 27th. (Date applied for under Rule 5, Patents Rules 1905, February 27th, 1906.)

Electric Motor Control Systems. British Thomson-Houston Co. (General Electric Co.) 4,926. February 28th.

Electric Fusible Cut-Outs. O. L. Peard. 5,171. March 2nd.

Electrically-Operated Power Transmission Mechanism. British Thomson-Houston Co. (General Electric Co.) 5,892. March 10th.

Magnetic Compasses. J. Leighton. 8,259. April 5th.

Armature Mounting for Electro-Magnetic Apparatus. C. H. North. 9,186. April 18th. (Date applied for under International Convention, April 22nd, 1905.)

Electric Bells and Installations for Working the same. W. Knight. 9,410. April 21st.

Electric Ignition Devices for Internal Combustion Engines. T. H. Gardner and E. Gardner. 9,792. April 26th.

Telemotor Apparatus for Ship's Steering Gear. H. H. MacTaggart and R. G. Scott. 12,578. May 30th.

Electrically-Operated Self-Levelling Marine Tables. C. W. Laskay. 13,955. June 18th.

Medical Apparatus for Administering Three-Phase Sinusoidal Currents. A. Lloyd. 14,780. June 28th.

Incandescence Bodies Composed of Tungsten for Incandescent Lamps. Consortium für Elektrochemische Industrie Ges. 15,021. July 2nd. (Date applied for under International Convention, July 5th, 1905.)

Time Measuring Device for Telephone Conversations. J. Rounsevill and A. Bilms. 15,7?4. July 12th.

Means for Operating the Valves and Sparking Apparatus of Explosion Engines. H. P. Martin and L. Lethimonnier. 16,193. July 17th. (Date applied for under International Convention, February 2nd, 1906.)

Electric Induction Furnaces. Gröndel Kjellin Co. and J. Härden. 16,269. July 18th.

Enclosed Electric Arc Lamps. J. Brockie. 16,410. July 20th.

Thermo-Chemical Generator of Electricity. P. L. Basset. 16,905. July 27th. (Date applied for under International Convention, July 27th, 1905.)

Dynamo-Electric Machines. C. P. Steinmetz. 17,560. August 3rd. (Date applied for under International Convention, August 7th, 1905.)

Supporting Devices for Electric Fans and Fittings. R. Leach. 19,331. August 29th.

Electro-Magnetically Operated Temperature Regulating Apparatus. F. Kaeferle. 19,387. August 30th.

Apparatus for Operating Electrically-Worked Semaphore Signals. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 19,639. September 3rd.

Alternating Current Electric Machines. Felten & Guilleaume Lahmeyerwerke Akt.-Ges. 19,717. September 4th. (Date applied for under International Convention, September 4th, 1905.)

Apparatus for Use in Signalling by Electro-Magnetic Waves. De Forest Wireless Telegraph Syndicate. (L. De Forest.) 19,878. September 6th.

Compensated Single-Phase Alternating Current Electric Machines. Felten and Guilleaume Lahmeyerwerke Akt.-Ges. 20,233. September 11th. (Date applied for under International Convention, October 2nd, 1905.)

Mercury Vapour or like Electric Lamps. L. A. Audibert. 20,235. September 11th. (Date applied for under International Convention, September 20th, 1905.)

Collector Rings for Dynamo-Electric Machines. J. E. Noeggerath. 21,003. September 21st. (Date applied for under International Convention, September 22nd, 1905.)

Fire Preventing Device for Use upon Electric Installations for Lighting, Heating and like Purposes. S. R. Evans. 21,308. September 26th.

Dynamo-Electric Machines of the Unipolar Type. J. E. Noeggerath. 21,670. October 1st. (Date applied for under International Convention, October 4th, 1905.)

Incandescent Electric Lamps. H. C. Hubbell. 21,675. October 1st.

Tremblers for Induction Coils. H. G. Prested. 22,606. October 12th.

Combined Intercommunication and Exchange Telephone System. I. B. Birnbaum. (Telephon Fabrik Akt.-Ges. vorm. J. Berliner.) 23,309. October 20th.

Electric Pedal for Railways. E. Janssen. 23,569. October 23rd.